Compressed Air Magazine

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CROSSING THE ANDES

ON THE COVER

UNTIL the airplane came into general use, the height of the Andes served as a great restriction to travel between the eastern and western parts of South America. Now thousands of persons annually cross this lofty range quickly and safely. Our cover picture shows a modern passenger airliner against a backdrop of solid rock. It is published through the courtesy of Pan American-Grace Airways, Inc.

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IN THIS ISSUE

PONTOON bridges ordinarily come into the news only when there is a war. Their principal use, since time immemorial, has been to provide quickly more or less temporary means of crossing rivers, particularly to replace fixed spans destroyed by a harassed army to delay pursuers. Permanent floating structures cannot be used where there is a considerable fluctuation in the water level, a factor that greatly limits their application. The Lake Washington Bridge that is described in this issue is outstanding in point of size. Its construction features are very simple, and its cost is surprisingly low in comparison with that of a conventional bridge of equal length.

●

THE origin of our weights and measures should interest everyone, regardless of age or calling. After reading Mr. Hoffman's article, it is easy to understand how the various values were established and why they persist. Just how much time and effort could be saved if universal systems of weights and measures were adopted is something that cannot be computed; but many persons would give thanks if this seemingly impossible objective could be attained. The author suggests a starting point that seems to us to be worthy of serious thought.

●

THE exploration of dam sites by means of core drilling is not new, but it has been carried on by the Tennessee Valley Authority to a greater extent than ever before. The TVA engineers were among the first to utilize holes of sufficient diameter to permit geologists to descend into them to examine the rock in place. Other dam builders quickly saw the saneness and effectiveness of this practice and were not long in adopting it. The core drill is an exceedingly valuable tool to the constructor, and it can serve him in many ways. Two widely different uses of large-diameter drills are described in the following pages by an engineer who is familiar with the entire core-drilling experiences of the TVA.

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BARNEGAT INLET, long a treacherous passage for boats to negotiate, is being made safer by two rock jetties. Their placing has involved numerous problems, not the least of which was the procuring of rock.

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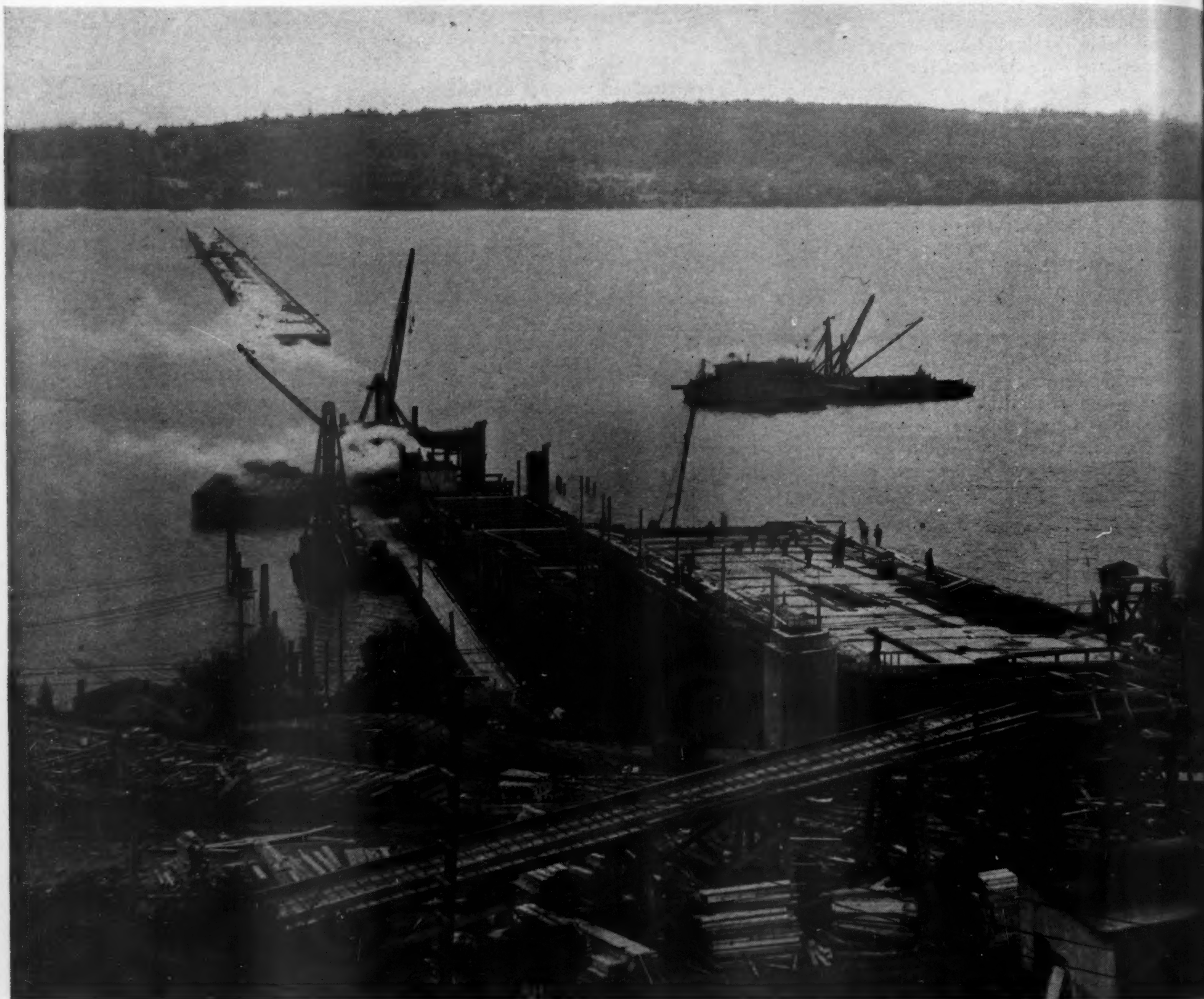
Seattle's Floating Bridge

Henry W. Young



PARTLY COMPLETED

A view looking eastward from the Seattle side of the lake, showing work in progress in the foreground on the approach to the pontoon bridge. Part of the pontoon structure can be seen in the water. Mercer Island is in the background.

A STORY that is now coming to a climax is told of a man named George Lightfoot, veteran mail carrier and for years president of the East Side Federated Clubs of Seattle, Wash. He is called the "daddy" of the Lake Washington Bridge, although he referred to it as the Mercer Island Bridge. Most great projects of this kind seem to have had in the remote background a man with an idea so strong that nothing could down it.

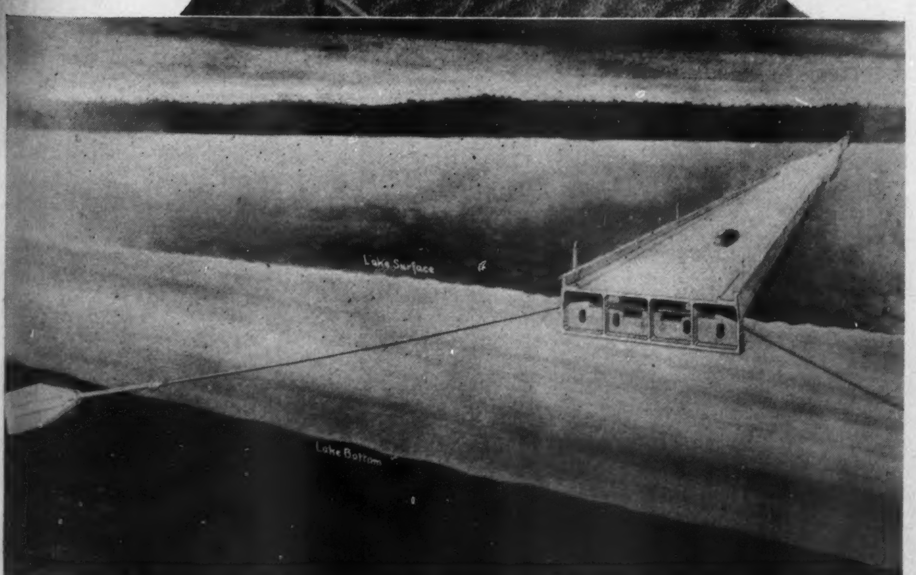
Mr. Lightfoot believed that a bridge from Seattle to Mercer Island would be a wonderful thing for the city, for the island is a large and beautifully wooded one that he envisioned as a paradise of homes if people could only get there without a ferry trip. The idea was talked about for many years; and it was always George Lightfoot who kept the talk going when it languished. And now Lake Washington Bridge is almost an accomplished fact. It is a bigger and a different kind of structure, perhaps, than the one Lightfoot had in mind, and a link in an even larger plan. By June or July of this year cars will be driving over it to Mercer Island and beyond.

Engineers and builders everywhere have been following this undertaking with keen interest, because the Lake Washington Bridge, the principal feature of the project, is unlike any other thus far built in this country. It is a floating bridge, made up of reinforced-concrete pontoons. There have been examples of wood and iron or steel pontoon bridges in Europe, and some of steel construction in this country. But in no previous case have the component structures been of reinforced concrete or of a size or character that could compare with these.

Seattle occupies a strip of land between Puget Sound on the west and Lake Washington on the east. In the southern part of the lake is Mercer Island, which covers 7

ARTIST'S DRAWINGS

At the right is a general sketch showing the route of the new highway, of which the floating bridge will form a link. At the bottom is a perspective drawing illustrating a section of the pontoon structure and the method by which it is anchored to prevent lateral movement. The draw structure that can be opened to permit boats to pass through is shown in the center. Its action might be compared to that of a gigantic slide rule. By means of cables and electric motors, the pontoon section at the left can be moved into the slot at the upper right, providing an opening 200 feet wide.

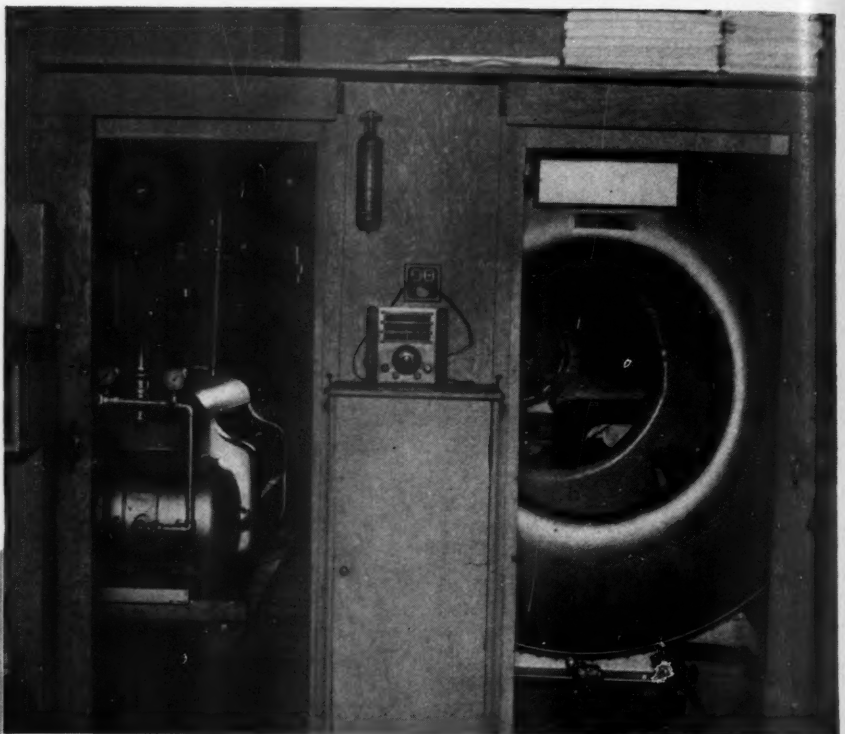


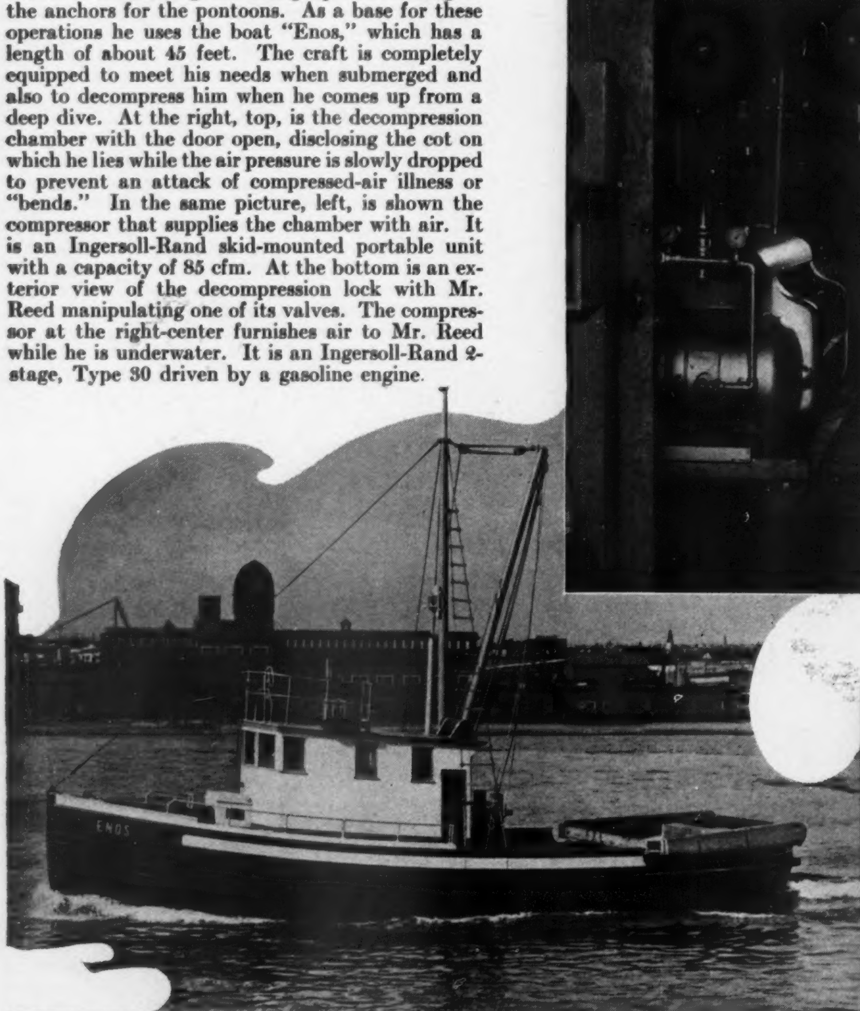
square miles and is exceptionally well situated for a suburban residential area. East of Lake Washington is Lake Sammamish, and beyond it are the Cascade Mountains. From Seattle eastward, the road most used is U.S. Highway No. 10, the Sunset Route, which crosses the mountains at Snoqualmie Pass, 3,004 feet above sea level. However, Lake Washington extends 11 miles north and 9 miles south of the center of Seattle, and traffic must, accordingly, move around one or the other end of that body of water, the Sunset Highway branching so as to go in both directions. The new crossing of the lake will, consequently, have a twofold benefit: it will make Mercer Island easily accessible, and it will provide a direct route for east- and west-bound automobile traffic. The saving in distance to users of the Sunset Route will be 14 miles, with a reduction in total curvature of from around 5,000° to approximately 1,000°.

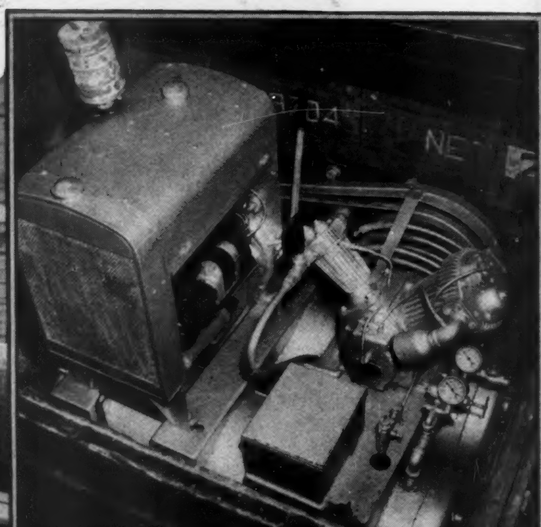
All told, the new highway now under construction will have a length of 33,968 feet, or approximately 6½ miles. It will

DIVER'S OPERATIONS

William Reed, well-known West Coast diver who worked on the San Francisco Bay Bridge, is submarine inspector at the Lake Washington Bridge and makes regular descents to depths as great as 217 feet in directing the lining up and sinking of the anchors for the pontoons. As a base for these operations he uses the boat "Enos," which has a length of about 45 feet. The craft is completely equipped to meet his needs when submerged and also to decompress him when he comes up from a deep dive. At the right, top, is the decompression chamber with the door open, disclosing the cot on which he lies while the air pressure is slowly dropped to prevent an attack of compressed-air illness or "bends." In the same picture, left, is shown the compressor that supplies the chamber with air. It is an Ingersoll-Rand skid-mounted portable unit with a capacity of 85 cfm. At the bottom is an exterior view of the decompression lock with Mr. Reed manipulating one of its valves. The compressor at the right-center furnishes air to Mr. Reed while he is underwater. It is an Ingersoll-Rand 2-stage, Type 30 driven by a gasoline engine.



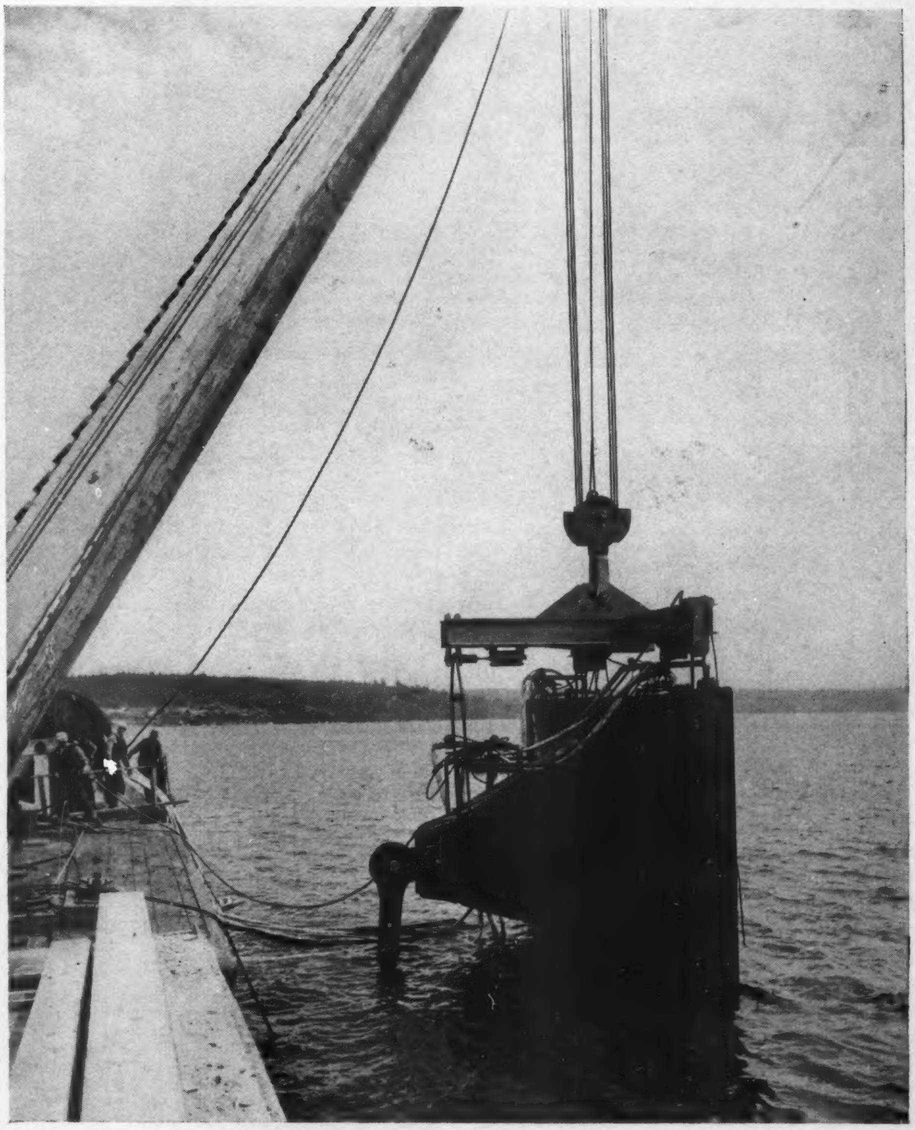




cost $8,854,400 of which sum $3,794,400 is a direct grant from the Federal Public Works Administration and $5,060,000 is being raised by the sale of toll-bridge revenue bonds. The project is under the direction of the Washington Toll Bridge Authority, which is also building the Tacoma Narrows Bridge that was described in our December, 1939, issue.

The Lake Washington highway has been divided, for construction purposes, into eleven units, each of which constitutes a separate contract. Starting in Seattle, the first unit covers 2,360 feet of 6-lane concrete roadway, and the second one a twin-bore tunnel, 1,487 feet long, through Mount Baker Ridge, one of the seven hills on which the city is located. Connecting with the tunnel will be a fixed bridge approach that will be 1,062 feet long and will be carried down to the east end of the floating bridge. Then will come the pontoon bridge, 6,561 feet long. An inclined approach, 960 feet in length, will connect with Mercer Island. Unit No. 6 involves the building of a 6,773-foot section of concrete highway on Mercer Island. The next unit will consist of grade-separation structures and also of the building of toll administration and collection facilities. Immediately following will be 7,741 feet of concrete roadway that will extend the line to the west side of Mercer Island. A fixed-span, steel-and-concrete bridge will serve as a crossing for the channel east of Mercer Island and will connect with a section of concrete highway 2,086 feet long. The final link will be a reinforced-concrete viaduct, 2,578 feet in length, that will span Mercer Slough. Except for the tunnels, each of which will accommodate two lanes of traffic, and Unit No. 1, the roadway will be four lanes wide. In addition, all the bridge structures will have two sidewalks.

As has already been mentioned, the pontoon-bridge section of the project commands major interest because of the unusualness of this type of construction. A pontoon structure was decided upon after exhaustive studies and investigations had indicated that all existing conditions favored it. Lake Washington ranges in depth from 150 to more than 200 feet, and its bottom is mostly soft clay as much as 100 feet deep. It is a fresh-water lake connected with Puget Sound by a canal and locks. Its surface elevation varies not more than 3 feet annually, and changes in level are never rapid. There are no currents to contend with, no drifting ice, and no large waves. Bridge engineers are agreed that, where it is suitable, a pontoon bridge is the most economical type to build. At most locations, however, great fluctuations in water level would render it difficult to maintain connections with fixed approaches, while swift currents, waves, or drifting ice might constitute unfavorable factors. For these reasons, pontoon bridges, although of ancient origin, are comparatively rare except where military objectives demand expediency.

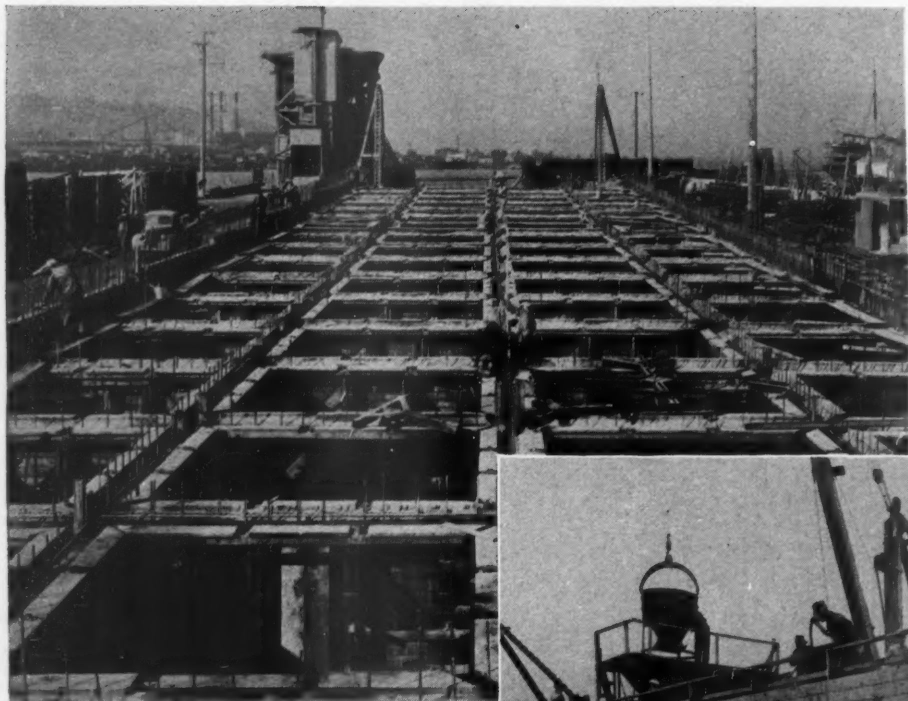


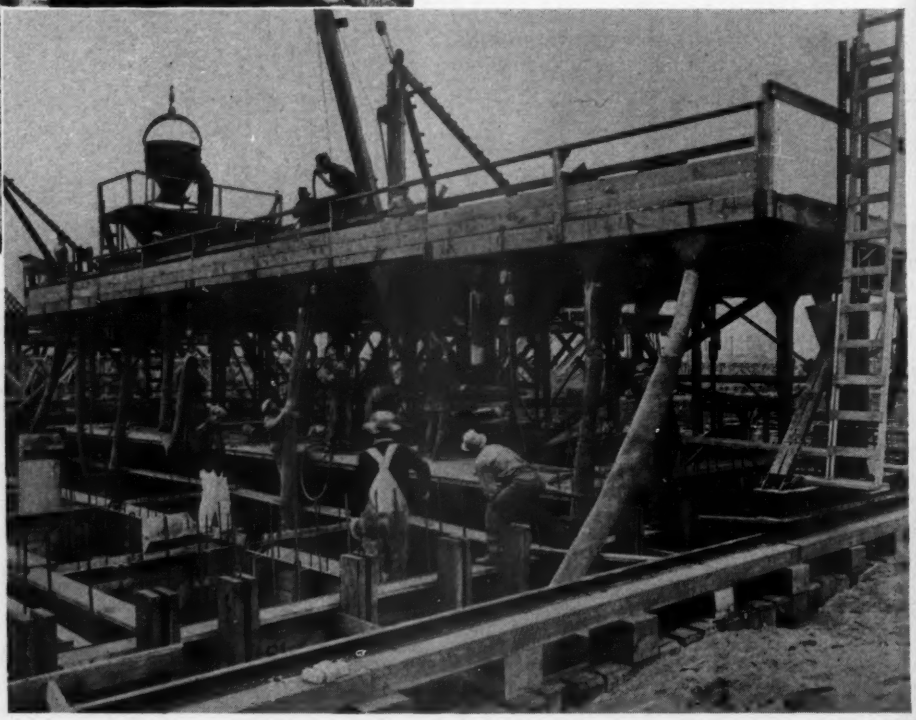
LOWERING AN ANCHOR

This type of anchor, made of concrete and steel and weighing more than 65 tons, is sunk into the mud at the lake bottom with the aid of water jets which are fed through attached hose lines. Each anchor is deposited on the lake bed in an upright position by means of the tackle shown. It is suspended from the structural-steel spider at three points by pins passing through hairpin-shaped rods. These pins must be withdrawn to release the spider, an operation that would ordinarily make it necessary for a diver to go down after the anchor has been bottomed. To obviate this, the spider has been equipped with three compressed-air cylinders the pistons of which are each connected to one of the pins. By admitting air into the lines, the pins can be withdrawn from the hairpin loops and the spider hauled up by the cable, bringing the water and air lines along with it intact—the metal pipe connections between the water hoses and the pipes embedded in the concrete being snapped off as a result of the lifting action. At the left edge of the anchor is the eyebar attachment for the cable that will link it with a pontoon. The connecting cables are 2¾ inches in diameter and have a maximum length of 650 feet.

The case in favor of a pontoon bridge at this location is summed up as follows by Charles E. Andrew, chief consulting engineer: "Water in the west channel of Lake Washington is more than 200 feet deep for a distance of somewhat more than 3,000 feet of the 8,000-foot crossing. The bottom is made up of clay for a depth of approximately 150 feet. Because of these facts, piers to support a conventional bridge would have to be seated more than 375 feet below water surface. It is very readily recognized that piers of this character would be far in excess of those built for the San Francisco-Oakland Bay Bridge, and would be extremely expensive. The estimated cost of a conventional bridge runs close to $20,000,000, while the west lake crossing now being constructed will have a total cost of slightly more than $4,000,000, or one-fifth that of a conventional bridge."

In the Lake Washington structure, which is approximately 1.25 miles long, there will be 25 reinforced-concrete pontoon sections, assembled end to end with adjacent ones permanently interconnected by means of 54 bolts, each 9 feet long and 2¾ and 3¼ inches in diameter. Two shear keys, 3 feet square, project 12 inches from one end of





CONSTRUCTING A PONTOON

One of the multicellular concrete structures (left) in a graving dock, with the top deck remaining to be poured. This is done from a gantry carriage (below) that spans the dock and travels on rails. Concrete is delivered to a hopper in buckets handled by a derrick and is discharged from the hopper into any one of the numerous "elephant trunks" that lead to various parts of the forms. In the upper picture on the opposite page is seen a finished pontoon. Note the openings in the end that are used for bolting it to an adjoining section. The other view shows a pontoon in Puget Sound being towed to the bridge site.

each pontoon and fit into corresponding recesses in the adjoining one. When two units are bolted together, rubber strips placed in each recess—a vertical one at each side near the outer edge and a horizontal one across the bottom—form a watertight seal so that the 1-inch space left between the sections can be unwatered and grouted by way of the top. The bolts are arranged 22 each across the top and the bottom, and five down each side. On the line of the bolts, at each end of a pontoon, there is a continuous recess, 8 inches wide and 2 inches deep, which is filled at the time of grouting and forms a shear band around the entire unit. The result of these construction methods is a monolithic structure, except where provision is made for a movable section to let ships through and also near the ends where the floating bridge will join the stationary approaches.

Of the 25 pontoons, ten are of standard section and fifteen are of special section to meet particular construction requirements. The standard section is 349 feet 10 inches long, 59 feet 8 inches wide, and 14 feet 6 inches deep. The units are of the cellular type, each standard section containing 96 cells and eleven intermediate bulkheads that divide it into twelve watertight compartments each having eight cells. The bottom, sides, and deck are of reinforced concrete 8 inches thick, while the intermediate cell walls and bulkheads are of 6-inch reinforced concrete. Each standard floating section weighs 4,558 tons and will draw 7 feet of water. The roadway will therefore be 7½ feet above the surface of the lake.

The chief reasons for choosing concrete as the construction material were comparatively low cost and the fact that the great weight and consequent deep submergence would make for greater inertia and greater stability in rough water. Aside from using heavy reinforcing and a uniform good-quality concrete that is carefully placed and cured, no special steps are being taken to waterproof the pontoons. Observation of reinforced-concrete barges, that were built in 1918 and that have been in service ever since, shows that they have deteriorated very little and leads to the conclusion that the cellular pontoon will be substantially leakproof. A manhole in the deck above each watertight compartment will make it possible to enter it to pump out water, should that become necessary. In the event the bridge is ever rammed, little fear is felt for its safety, as one or even two compartments of a pontoon could be flooded without overstressing it or causing it to sink.

To resist the horizontal forces of wind and waves, both transverse and longitudinal anchorages are provided. These are of three types, the most numerous of which consists of a precast reinforced-concrete-and-steel-plate assembly that is used where the lake bottom is soft mud. It is fitted with jet pipes for sinking it into the lake bed. Where the water is shallow and the bottom is hard and firm, steel-pile assemblies with steel eyebar attachments are placed. Where a bottom with medium resistance is encountered, a reinforced-concrete box with bottom lugs is sunk and afterward filled with tremie-poured concrete.

The anchors are designed to resist the forces set up by a 90-mile-an-hour wind and the accompanying waves, with a factor of safety of approximately three. The greatest wind velocity ever recorded on Lake Washington was an instantaneous gust of 87 miles an hour. As designed, the bridge is estimated to move laterally a maximum of slightly less than 2 feet in a 90-mile wind. During recent storms, with 4,200 feet of the bridge in position, winds with velocities up to 50 miles an hour shifted the structure sidewise about 2 inches. Since the pressure of wind and wave varies approximately as the square of the velocity, a 100-mile wind would deflect the bridge four times as much as a 50-mile wind, or about 8 inches. In comparison, the Golden Gate

Bridge at San Francisco has been known to move sidewise 12 feet in a 70-mile wind! Because of the continuous action obtained by rigidly connecting long sections of pontoons, the Lake Washington Bridge will experience no notable deflection under the heaviest roadway traffic.

The anchors are attached at the middle of each pontoon by 2¾-inch cables up to 650 feet long and connected by means of structural-steel devices located in the interior of the pontoon and arranged so as to permit making adjustments in the cable length. Attachment to the concrete anchors is made with steel links. Sixty-four anchors of all types will be required; and divers have worked in water as deep as 217 feet to aid in lowering and lining them up. Those that are sunk in the bottom each contain 65 tons of concrete, while the concrete boxes for the medium-hard bottom weigh 75 tons each, submerged. In some cases, rock is piled in front of them.

A novel application of compressed air is made in connection with the placing of the precast concrete anchors in deep water. It saves a diver many hours of work at the bottom, and shortens the tedious decompression period which he must undergo in coming from great depths. An anchor of this type is shown in one of the accompanying illustrations. The hoses that are seen feed water at a pressure at 200 pounds per square inch to the jets on the anchor's cutting edge that loosen the underlying material and thus aid in sinking the anchor. The water passes from the hose connections to the jets through pipes embedded in the concrete. A steel spider takes the weight of the anchor, holding the latter by means of steel cables and hairpin tackle that grip the ends of movable, horizontal pins.

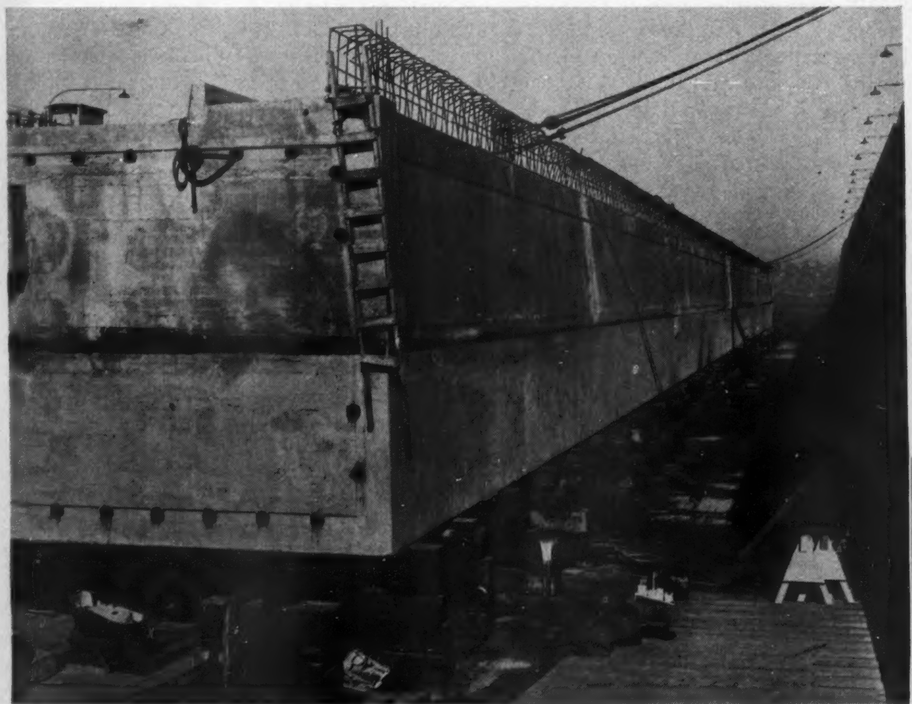
When the anchor is on the bottom and in place, it would, ordinarily, be necessary for a diver to go down and laboriously release the pins from the hairpin loops. This has been obviated by providing each pin with a compressed-air release. It is a simple cylinder with a piston connected to the pin; and when air pressure is applied the piston moves and draws the pin out of the hairpin loop. The spider is then free to be drawn up by the cable, bringing the water and air lines up with it intact. The metal connections between the water hose and the pipes embedded in the concrete are simply snapped off when the spider is hoisted.

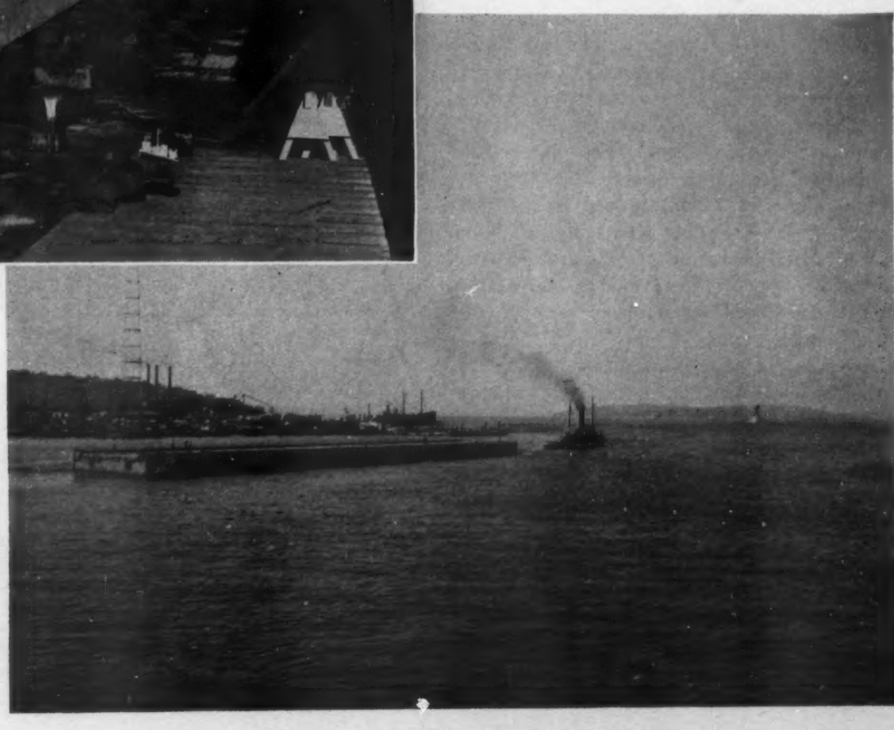
To permit boats to go through the bridge, one of the pontoons, located about 1,500 feet from Mercer Island, will be movable. It will be retracted into a Y-shaped opening formed by two adjacent pontoons and offer a 200-foot channel. This draw structure will be 378 feet long. Furthermore, one of the spans of each approach to the bridge is a steel arch 215 feet long and 30 feet above the water for the passage of small craft.

At the transition point between the approach structures and the floating bridge, the pontoon sections will be varied in design so as to serve as supports for the end spans of the approaches and to allow for fluctuations in the lake level, as well as for expansion and contraction. At these locations provision will be made for flooding or pumping out certain cells to control flotation and to compensate for variations in water level.

The pontoons are constructed, complete except for their hand rails, in two graving docks that were built for that purpose on the Puget Sound waterfront of Seattle. As each is finished, it is floated out of the dock at high tide and towed to the bridge site via Lake Union and the canal that connect Puget Sound with Lake Washington. The total journey is about 25 miles, although the graving docks are only about 4 miles from the bridge location in a direct line.

The graving docks are each 70 feet wide and 365 and 400 feet long, respectively. After the excavations for them had been completed, piling was driven at the sites to support the heavy floor frames, which were covered with permanent wood flooring. The sides of the docks are of timber sheet piling. When making ready to pour a pontoon, the reinforcing steel is put in position





ONE USE OF AIR

Thousands of bolts are used over and over in successively assembling and dismantling the forms in which the concrete pontoons are poured in the graving docks. The bolts are subjected to considerable abuse, and two men are kept busy putting them back in service condition. Ingersoll-Rand Size 13 air drills equipped with special chucks are used for cleaning the threads, as shown here.

on the floor, together with cast-iron chairs on which box forms are then set up so that the spaces between them will serve as the forms for the partitions and bulkheads. For the outer walls there are side and end forms of wood made up in units, one for each cellular space.

Exclusive of the floor, approximately 150,000 square feet of lumber was required for these forms: 20,000 feet was ½-inch plywood for the deck forms and the remainder was 2-inch tongue-and-groove boards for the box forms. Every piece was treated with oil and paraffin at a temperature of 160°F. to insure penetration. The deck lumber was treated with waterproof glue.

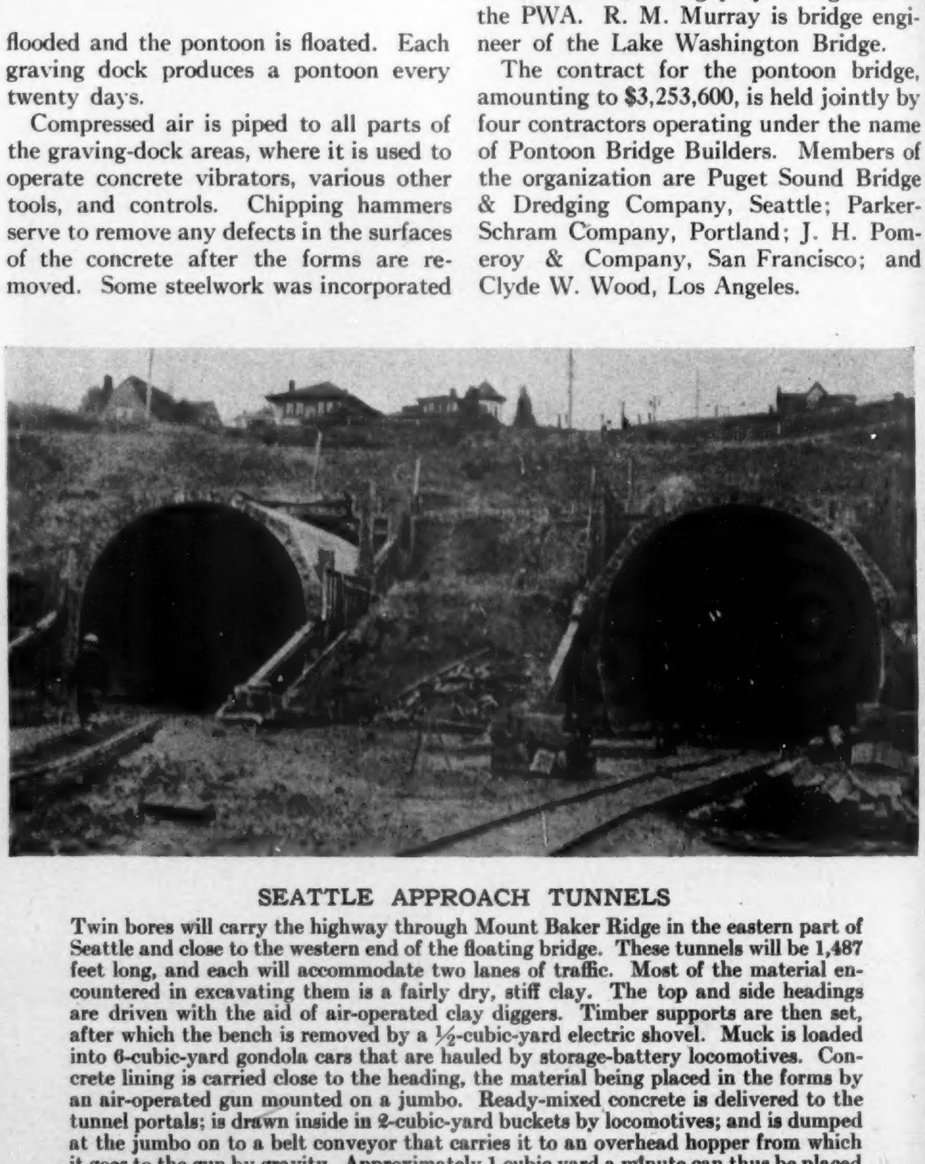
With the forms and reinforcing in place, the concrete is poured through a system of spouts on a traveling bridge, the material being received in a bridge hopper and transferred in buggies to the spout openings. A concrete mixing plant with two 1-cubic-yard mixers is located between the docks, which are 140 feet apart. The material is discharged from the mixers into four 2-cubic-yard buckets on flat-bed trucks and transported to a point where the buckets can be lifted by a crane and dumped into the bridge hopper. The concrete is a plastic mix containing 1½ barrels of cement per cubic yard.

All parts of each pontoon excepting the roadway slab are placed in a continuous pour of 1,338 cubic yards. The concrete in the wall sections is compacted with vibrators that are lowered into the forms through openings in the floor of the bridge. The average placement is about 70 cubic yards an hour. The deck is poured last and, after 60 hours, the inner surfaces are cured with a special compound while the outer sides and roadway slab are cured under cotton mats. Four and a half days after the latter slab is completed, the dock is flooded and the pontoon is floated. Each graving dock produces a pontoon every twenty days.

Compressed air is piped to all parts of the graving-dock areas, where it is used to operate concrete vibrators, various other tools, and controls. Chipping hammers serve to remove any defects in the surfaces of the concrete after the forms are removed. Some steelwork was incorporated in the transition pontoons next to the approaches to the floating bridge, and riveting hammers were employed in fabricating it.

The Washington Toll Bridge Authority, which is carrying out the Lake Washington Bridge Project, was created by legislative act in 1937. Its personnel consists of Gov. Clarence D. Martin; Lacey V. Murrow, Director of Highways, chief engineer; and four other state officials. Its engineering consulting board is composed of C. E. Andrew, formerly principal bridge engineer San Francisco-Oakland Bay Bridge, chairman; L. E. Gregory, Rear-Admiral U.S. Navy, retired; R. B. McMinn, bridge engineer U.S. Bureau of Roads, District No. 1, Portland, Oreg.; and R. H. Thompson, consulting engineer, formerly city engineer, Seattle. The engineering personnel of the Authority in charge of the construction of the Lake Washington Bridge and also of the Tacoma Narrows Bridge consists of C. E. Andrew, principal consulting engineer; Lacey V. Murrow, chief engineer; L. R. Durkee, acting project engineer of the PWA. R. M. Murray is bridge engineer of the Lake Washington Bridge.

The contract for the pontoon bridge, amounting to $3,253,600, is held jointly by four contractors operating under the name of Pontoon Bridge Builders. Members of the organization are Puget Sound Bridge & Dredging Company, Seattle; Parker-Schram Company, Portland; J. H. Pomeroy & Company, San Francisco; and Clyde W. Wood, Los Angeles.



SEATTLE APPROACH TUNNELS

Twin bores will carry the highway through Mount Baker Ridge in the eastern part of Seattle and close to the western end of the floating bridge. These tunnels will be 1,487 feet long, and each will accommodate two lanes of traffic. Most of the material encountered in excavating them is a fairly dry, stiff clay. The top and side headings are driven with the aid of air-operated clay diggers. Timber supports are then set, after which the bench is removed by a ½-cubic-yard electric shovel. Muck is loaded into 6-cubic-yard gondola cars that are hauled by storage-battery locomotives. Concrete lining is carried close to the heading, the material being placed in the forms by an air-operated gun mounted on a jumbo. Ready-mixed concrete is delivered to the tunnel portals; is drawn inside in 2-cubic-yard buckets by locomotives; and is dumped at the jumbo on to a belt conveyor that carries it to an overhead hopper from which it goes to the gun by gravity. Approximately 1 cubic yard a minute can thus be placed in each tunnel. Compressed air is supplied to the bores by a 700-cfm., stationary, diesel-engine-driven compressor and three portable machines, two of 315-cfm. and one of 370-cfm. capacity.

Sidelights on Our Weights and Measures

Paul Hoffman

ARISTOTLE is supposed to have made the remark that science begins with measurement. Seemingly, a profound and pertinent observation! The wonder of it is that, with the methods of measurement then in usage, there should have been any beginning at all. And granting, further, that progress in science should, of necessity, demand increasing refinement in the methods of measurement, how, then, explain the survival in the United States and throughout the British Empire of the so-called English System of Weights and Measures which, in many respects, shows little advance over the ancient practices of the Greeks—in fact, is so little adapted to scientific purposes that it has been abandoned by physicists and chemists in a body?

Indeed, the advocates of the metric system condemn our English system lock, stock, and barrel as a jumble of unrelated units which are as senseless as they are obsolete. They call it a burden on our school children, a source of endless confusion, and a handicap to industry, trade, and commerce. On the other hand, its apologists stoutly defend this venerable code of metrology as part of our English heritage, endeared to us by sentiment and tradition; and if they admit of some of its inconsistencies, they regard them merely as delightful oddities.

It is not proposed here to enter into this controversy, nor to investigate why the metric system, with all its supposed superiority, has failed to displace the English units in everyday use. Rather would we invite the reader to consider the why and wherefore of some of the common English units and to uncover their roots and derivations through an historical approach to the general subject of measuring and weighing.

Let us examine the simpler units of length first, and try to trace their lineage. Quite naturally, our ancestors, for want of stable and fixed references, looked to the human body as the basis of their primitive standards. They made use of the fingers, the thumb, and the span; the palm of the hand, the forearm or ell, and the foot; a man's height or its equivalent, the spread of his outstretched arms; and of a step or pace. The thickness of a finger (digit) was about ¾ inch; that of the thumb 1 inch (in French an inch is literally a thumb—*un pouce*); a hand was four digits; a fathom equals a man's height, or 6 feet (the French making it *brassée* or arm spread), etc.

Evidently, such natural measurements vary with the individual, and if an average were selected this, too, would vary in accordance with the race of people. This explains why these primitive units were never alike. For instance, a Roman *pes* measured 11.64 (English) inches; the old Rhenish *Fuss*, prevalent in Central Europe, 12.36 inches; a Swedish *fot*, 11.7 inches; the Spanish *pie*, 11.13 inches. The standard French foot, before the adoption of the metric system, was the *Pied du Roi*, the king's foot, of 12.57 inches, surprisingly long in view of the relatively short stature of Frenchmen. The English foot seems to have been taken over not from the Anglo-Saxons or Normans but, strangely, from the continental tribe of the Belgae, some of whom migrated to the British Isles in the second and third centuries.

Among units of length, however, it is not the foot but the cubit which has the oldest standing—the cubit being the length of the forearm from elbow to extended fingertips. This was the base unit or standard of the ancient peoples of Chaldea, Babylon, and Egypt, and was, somewhat awkwardly, subdivided into seven palms of four digits each. The older Egyptian cubit measured 20.6 inches, as is verified on numerous temples and monuments; but this length has varied up and down through the ages.

Drawings by Arval Grover

THE CUBIT

THE STONE

The cubit of the Hebrews in Solomon's time seems to have been 17.6 inches, which would make the height of Goliath, recorded as "six cubits and one span," about 9 feet 6 inches, something which has not been equaled by any modern freak on record.

The later and shorter cubit seems to have been divided into 25 digits for convenience' sake, which left the digit at about the same value—¾ inch. This cubit remained in use up to comparatively modern times, and was still recognized as a secondary standard measure in the United States of America as recently as 60 years ago, according to an old edition of Webster's in which its length is given as 18 inches.

In time, the foot supplanted the cubit as the common unit of length. It seems to have originated in Asia Minor and to have been taken over subsequently by Greece and Rome. Originally, 1 foot equaled 3/5 cubit; and of special interest is the fact that this old foot was still subdivided into digits, sixteen of them, somewhat readjusted in length so that things would come out even. The subdivision into 12 inches (from the Latin *uncia*, or one-twelfth) occurred later in Rome, where they had a particular liking for the duodecimal system.

It might be noted, in passing, that the Greeks recognized no fewer than three different lengths for the foot. They had one of 12.45 inches for itinerary purposes (600 of these feet measured off a *stadion*, equivalent to about 208 English yards, which our track athletes might adopt as a unit instead of continually arguing over yards and meters!); then there was an agrarian foot of 12.16 inches used in measuring land; and, finally, the shorter Attic foot of 11.6 inches came into style, and this was the one eventually taken over by the Romans.

An interesting historical sidelight is that the same older Greek foot of 12.45 inches was used also by the Phoenicians. During their travels they must have acquainted the Celts in England with it, for in the druidic Stonehenge monument the vertical stone slabs are, apparently, arranged in a circle of exactly 100 of these Phoenician feet. However, this was a passing phase in the development of an English standard, for, as already remarked, they later adopted the shorter Belgian foot.

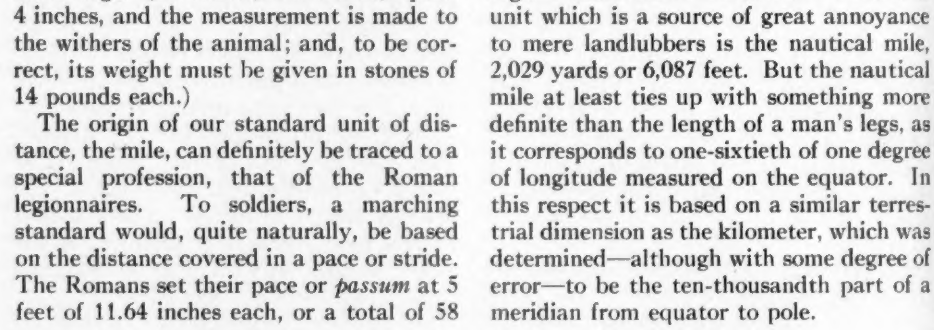
On the other hand, the yard (3 feet) is an original Anglo-Saxon measurement, the meaning of the word being rod, or wand (to speak of a yardstick is, obviously, repetitious). A yard of 36 inches was in use as a recognized English standard throughout the Middle Ages, although, parallel with it, certain variations were in favor in special trades. For quite a while a "clothes-ell" of 37 inches was in existence, while another odd measure was a "yard-and-a-handful" of 40 inches. The present legal standard yard, or imperial yard, dates from 1844, when it was fixed at 0.914399 meter. This, unfortunately, makes it about 1 part in 100,000 shorter than the United States standard yard—not a large discrepancy, to be sure, but just another thing to bedevil those who deal in accurate measurements.

As already noted, special units besides those officially sanctioned were always and are still in use in certain trades or callings. To cite one amusing instance, a horse is invariably spoken of by all real fanciers, both British and American, as being so many hands high. (The hand, in this case, equals 4 inches, and the measurement is made to the withers of the animal; and, to be correct, its weight must be given in stones of 14 pounds each.)

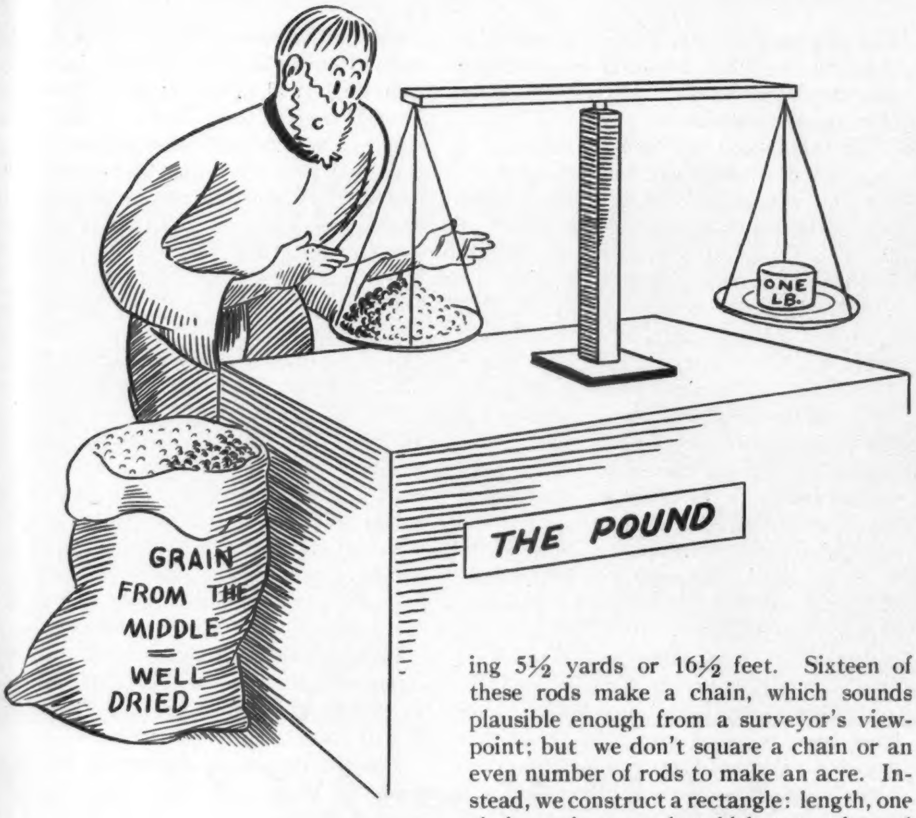
The origin of our standard unit of distance, the mile, can definitely be traced to a special profession, that of the Roman legionnaires. To soldiers, a marching standard would, quite naturally, be based on the distance covered in a pace or stride. The Romans set their pace or *passum* at 5 feet of 11.64 inches each, or a total of 58 inches, and a thousand paces—*mille passuum*, is therefore 1,000 strides or double steps. It must, of course, be noted that in current usage a pace has become the equivalent of only one step, 2½ feet, although a geometrical pace of 5 feet was formerly also recognized. In the U. S. Army, for instance, marching at double time means at the rate of 180 paces of 3 feet per minute.

Actually, our statutory mile, 5,280 feet, has become somewhat more than the equivalent of 1,000 paces, and it is substantially longer than the Roman mile of 4,833 (English) feet. In other countries the variations were even greater, or other units, such as the league, were in usage. Our subdivision of the mile into eight furlongs springs from a local English custom, the furlong being an Anglo-Saxon measure expressing the conventional length of a furrow.

If soldiers are responsible for our land mile, we owe to sailors the introduction of other special units of length. They measure ocean depths in fathoms of 2 yards (equal to a man's arm spread); 50 fathoms make a "cable"; and the speed of ships is reckoned in knots, from the knots tied at regular intervals in a bowline. Their one unit which is a source of great annoyance to mere landlubbers is the nautical mile, 2,029 yards or 6,087 feet. But the nautical mile at least ties up with something more definite than the length of a man's legs, as it corresponds to one-sixtieth of one degree of longitude measured on the equator. In this respect it is based on a similar terrestrial dimension as the kilometer, which was determined—although with some degree of error—to be the ten-thousandth part of a meridian from equator to pole.



THE MILE



In considering surface measurements, it is more difficult to establish the connection between the English and the ancient systems. The Greeks and the Romans used straight multiples of their respective square foot for their larger units of area. The multiples themselves, however, were quite odd. The upward sequence in the Roman system was 100, 36, 4, 2, 2, and 100, which led to a *centuria* of about 124 acres, while the Greeks went first to 36 square feet, then to a unit 100 times larger, etc., reaching a *plethron* of about a quarter of an acre as their largest unit. Their farming was, obviously, on a small scale.

Bible readers may remember the Jewish land measure, translated as an acre, which was the area of land that a plowman with one ox could turn over in a day. This must have been a rather flexible unit, involving no less than four variables. But it is significant in that it shows how land measures originated with agriculture and how they were tied up with a day's work as a unit. (Somewhat similarly the Bible refers to a day's journey as a unit of distance, equaling about 25 miles: a Sabbath day's journey was one twentieth of that.)

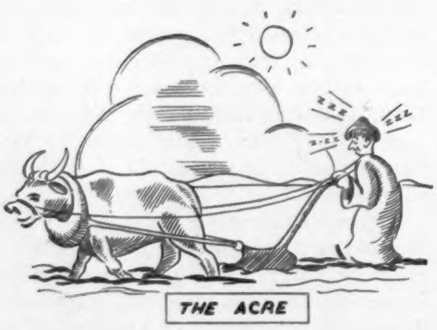
The word acre is of Anglo-Saxon or Teutonic origin, the equivalent German term being *Acker*. What amount of land an ancient acre covered is uncertain; but what is certain is that the way we define and determine an acre gives quite a wrench to logic. To begin with, we must use a new unit of length, variously called a rod, a perch, or a pole, which has no connection with the already established standards of the yard, or the foot, and is not even a straight multiple thereof—one rod equaling 5½ yards or 16½ feet. Sixteen of these rods make a chain, which sounds plausible enough from a surveyor's viewpoint; but we don't square a chain or an even number of rods to make an acre. Instead, we construct a rectangle: length, one chain or sixteen rods; width, ten rods; and the area of this rectangle of 160 square rods is our present acre. Of course, a rectangle of 20x8 rods will yield the same result; but a square would have to have the very odd side of 12 2/3 rods to give the same unit area of 160 square rods. Expressed in other units, the acre corresponds to 4,800 square yards, or to 43,560 square feet, numbers which are nothing but a burden to the average man's memory. The next larger unit of area is a square mile, 640 acres, which, in the case of U. S. Government surveyed land, constitutes a section, with a quarter section representing a farm of the usual size in our midwestern states. Thirty-six sections finally form a township.

Here we should really pause for a moment and reflect on the enormous practical difficulties that a change from our land measures to the metric system would involve. Would we have to divide this country all over again into hectares? Or should we have to refigure it all at the rate of one acre to 0.4047 hectares? A nice little job either way! Our Canadian neighbors would be faced with the further task of reducing the old French land measurements of the Province of Quebec, where the so-called *arpent* still prevails, an area slightly short of an acre—180x180 French feet square.

But enough of these surveyors' problems, and let's turn to another somewhat muddled subject, weights. It seems that, to satisfy everybody, we need three systems of weight: avoirdupois, troy, and apothecaries'. At least, all three have the grain in common, and there are only two different pounds: the avoirdupois pound of 7,000 grains, and the troy or apothecaries' pound of 5,760 grains. Besides, the two latter systems interest only jewelers, assayers, and druggists, so may be dismissed from further consideration, except, perhaps, to mention that troy weights don't really go back to the city renowned through the Iliad, but were named after the Town of Troyes, in France, which seems to have been a particular stronghold of gold- and silversmiths.

In general, the need for units of weight is as old as that for standards of length. It arose, probably, with the earliest dealings in barter and trade. The very term avoirdupois, in its original French-Norman spelling *aver de pes*, means goods of weight. For such goods it was necessary to establish standards of appraisal and comparison, and it is no surprise to learn that standard sets of stone and metal weights are always found by archeologists in ancient temple diggings. Apparently, there was a connection in those days between units of weight and monetary units. This is brought out, for instance, by the fact that a pound sterling was actually the value of one pound of fine silver. Similarly, the old French *livre* and the Italian *lira* are derived from the Latin *libra*, or pound (which also stood for scales). Then there is our pennyweight or dwt., as it is abbreviated; and in olden times there were numerous units such as shekel, talent, and obolus, which were both weight and currency standards. In fact, coins actually served as weights, and the ever-present tendency to debase currency by lightening coins had a way of confusing weight standards as well.

How the particular weight unit of the pound (from *pondus*, weight, in Latin) originated is explained by its old English definition, which describes it "as the weight of 7,680 grains of wheat, taken from the middle of the ears and well dried." A grain, as the lowest fractional part of a pound, is therefore to be taken literally as the weight of one grain of wheat. The change to a pound of 7,000 grains dates from the reign of Henry VII of England. The ounce was originally a twelfth of a pound, the root of the word ounce being the same as that of inch, the Latin *uncia*—one-twelfth. It has lost its original meaning in the avoirdupois pound of 16 ounces,



THE ACRE

but preserved it in the troy and apothecaries' pound of 12 ounces. The Roman pound or *libra* weighed 5,046 grains, and remained exactly at this value in Italy, Spain, and Portugal until these countries adopted the metric system.

A rather curious, larger unit of weight is the hundredweight, cwt. It seems to be a sort of natural weight, since weight units of the same order were in use in many countries—the talent, quintal, Zentner, etc., all corresponding approximately to the load which a man could carry, not too uncomfortably, on his back. The odd feature of the English hundredweight was that it ran to 112 pounds. Besides, there was a long hundredweight of 120 pounds. Today the U. S. hundredweight or cental is fixed at 100 pounds in accordance with its name, while our long hundredweight is 112 pounds. The English hundredweight is subdivided into quarters and half-quarters or stones, each equal to 14 pounds. The 14-pound stone seems to have been used for animals on the hoof, while butchers, peculiarly, had a stone of 8 pounds, or a fourteenth of a hundredweight, for dressed meat—the difference, probably, between gross and net weight.

A certain confusion of terms exists also regarding the ton, a large weight common to various countries under similar names—*tonneau* in French, *Tonne* in German, etc., all meaning a large tun or cask. We distinguish between a short ton of 2,000 pounds and a long ton of 20 hundredweights or 2,240 pounds, the use of one or the other depending on the materials handled. For instance, the weight of pig iron is usually given in long tons, as is the weight of anthracite coal at the mine—but not when delivered to the customer. The metric ton of 1,000 kilograms or 2,204.6 pounds is so nearly like a long ton that confusing the two leads to no serious mistake.

But the chance for error and real trouble comes in when referring to the tonnage of ships. There, the ton may be either a unit of weight or of capacity, according to whether it is a displacement ton—that is, the weight of the water displaced by the ship—or a burden or a register ton, both of which are measures of the cubical content of a ship or a certain part thereof. A register ton represents 100 cubic feet of the permanently inclosed space in the ship, with certain deductions: the burden or shipping ton equals 40 cubic feet (U.S.) or 42 cubic feet (British) of the cargo space. The displacement ton applies to warships only; the two others are used for passenger and merchant vessels; and all three are far from interchangeable.

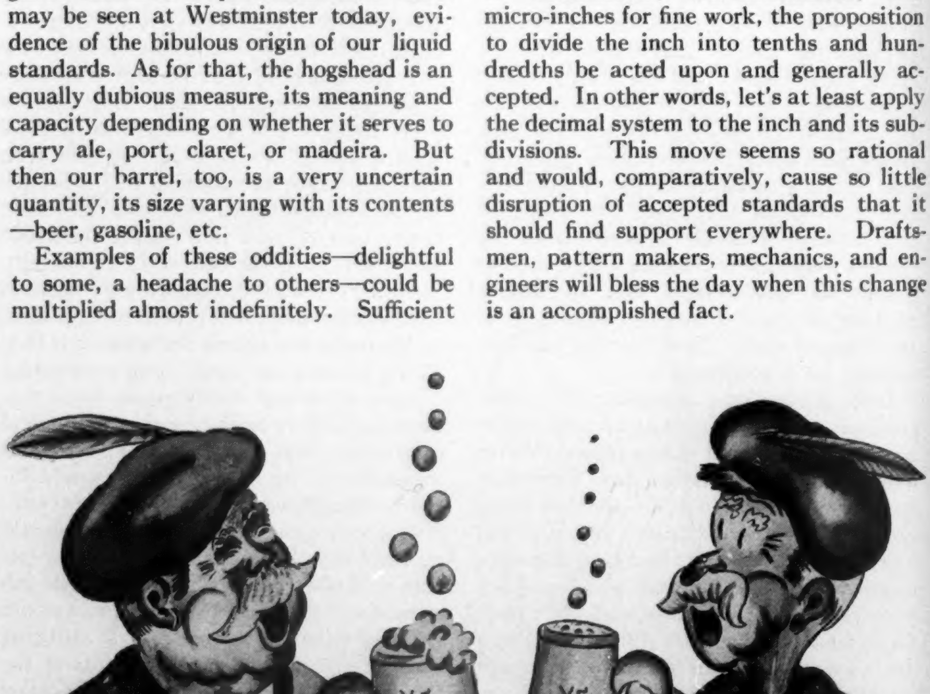
We shall dwell only shortly on units of capacity, dry and liquid, which completely bewilder the uninitiated by their variety and their inconsistency. Let's select at random a few of the existing oddities. First, though their practices agree in virtually all other respects, the British and American standard units for the gallon and the bushel are at variance. The U. S. gallon is defined as a measure holding 231 cubic inches, while the British or imperial gallon has a content of 277.418 cubic inches. The explanation for the difference is that both gallons were, in fact, valid old English liquid measures, the wine gallon and the ale gallon. The wine gallon became the U. S. standard: the ale gallon became the British standard after a slight modification of its original content of 277 cubic inches by an Act of Parliament in 1827 made it hold exactly 10 pounds of water at 52°F.

Why two standards of volume should have been required originally is another question. Perhaps they represented a consumer's maximum capacity for those beverages in an evening of solid drinking? At any rate, two "standard" wine- and ale-gallon tankards of pre-Elizabethan times may be seen at Westminster today, evidence of the bibulous origin of our liquid standards. As for that, the hogshead is an equally dubious measure, its meaning and capacity depending on whether it serves to carry ale, port, claret, or madeira. But then our barrel, too, is a very uncertain quantity, its size varying with its contents —beer, gasoline, etc.

Examples of these oddities—delightful to some, a headache to others—could be multiplied almost indefinitely. Sufficient evidence has been adduced to prove that our system of units is far from being systematic, logical, or convenient. The reason is very simple: like Topsy, it just grew. And as a natural and living growth, though rank with wild shoots and loaded with dead wood, it retains its vitality today. As against this, the metric system is infinitely simpler; but it is also entirely artificial, without any emotional appeal.

Does this explain it all? Of course not! There are really almost insuperable practical difficulties opposing any change. Millions are tied up in every manufacturing establishment in tools, fixtures, drawings, all made to English dimensions, in scales, weights, containers of every kind in everybody's hands. An enormous investment would become worthless if the English weights and measures were to be abandoned. But is not the gain worth the price? Hazarding a guess, we would say "yes"; and believing that a unified world system of weights and measures would promote international understanding and technical as well as scientific progress, we hope that it will come about eventually.

For the immediate future we are more modest. We merely hope and urge that, instead of using the binary fractions of ½, ¼, etc., down to 1/64, and then dropping to thousandths, ten-thousandths, and micro-inches for fine work, the proposition to divide the inch into tenths and hundredths be acted upon and generally accepted. In other words, let's at least apply the decimal system to the inch and its subdivisions. This move seems so rational and would, comparatively, cause so little disruption of accepted standards that it should find support everywhere. Draftsmen, pattern makers, mechanics, and engineers will bless the day when this change is an accomplished fact.



THE GALLONS

Two TVA Core-Drill Jobs

*Philip H. Kline**

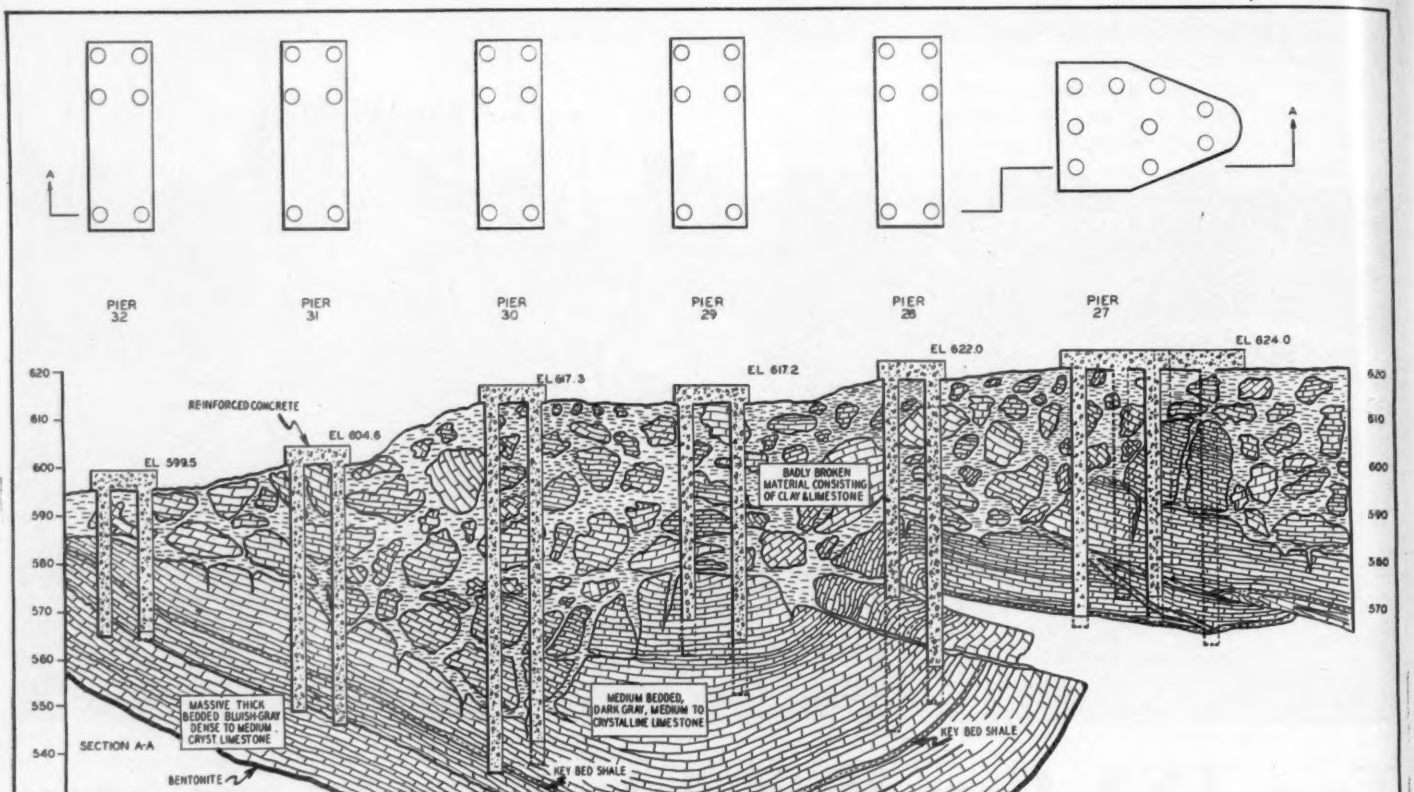
CORE-DRILLING experiences of the Tennessee Valley Authority are extensive, and are being applied increasingly in boring holes of large and small diameter for exploratory and construction work. Previous articles on the subject published in COMPRESSED AIR MAGAZINE (August, 1934, and May, 1936) discussed the general program of the Authority, with its regional development and water control of both rivers and land, and gave construction details of specific jobs at Norris and Wheeler dams. Among the more recent equipment operations of the TVA have been two core-drilling projects that are outstanding by virtue of their difficulty and results. One, at Chickamauga Dam, just above Chattanooga, Tenn., involved the boring of holes 36 inches in diameter for foundation bearing columns averaging 50 feet deep. The other unusual set-up was at the Watts Bar Dam site where exploratory drilling was conducted midstream of the Tennessee River from a floating-rig assembly. The accompanying notes and illustrations outline these two jobs.

In preparing the foundation for the navigation lock at Chickamauga Dam, Calyx core drills were used to considerable advantage. The overburden in one section of the excavation exceeded 50 feet in some places, and was composed of soft clay containing numerous bowlders of various sizes. The underlying ledge rock had an extremely irregular surface, typical of weathered limestone. There were also many sharp folds and faults with strata of shale and bentonite, as well as numerous open seams, weathered joints, and fissures which al-

*Construction Plant Operations Engineer, Tennessee Valley Authority

DRILLING AT CHICKAMAUGA DAM

The upper picture shows a general view of the section of the lock site where core drilling was done. At the right, Pier 29 has been built to a height of 30 feet, while Pier 28 at the left has been poured to ground level. Calyx core drills are working in the area at the left. At the bottom is a close view of two Class WS 36-inch drills and one Class SC 72-inch drill in operation.



GEOLOGICAL CROSS SECTION AT LOCK SITE

The plan drawings at the top show the form and relative positions of the foundations for the six piers used to support a part of the lock wall at Chickamauga Dam. These piers are, in turn, supported by reinforced-concrete piles that were poured in 36-inch-diameter holes sunk by means of Calyx core drills. The locations of the holes are indicated by the circles. The generalized geological section of the river bottom shows the course of the holes and the character of the material penetrated. It can readily be seen that difficulties would have beset any attempt to excavate for the pier footings by conventional methods. In making the 39 borings, 2,241 lineal feet of hole was drilled.

lowed ground water free passage. From preliminary exploratory drilling it was known that solid rock existed below these irregular layers. To avoid excessive open-cut work, which was considered unsafe and uneconomical, it was decided that the part of the lock wall in question could best be supported by means of reinforced-concrete columns which could be placed in holes bored through the overburden and into solid rock. The sketch above shows in detail the geological conditions encountered.

Before the holes for the concrete columns could be drilled, the overburden had to be excavated to a subgrade that would allow the pouring of reinforced-concrete pads level with the lock floor. These pads were placed at the location of each lock-wall pier, and provided the foundation necessary for the core drills and the working area. Thirty-nine holes were then put down for the columns that were to support six piers, each hole being drilled to solid rock, calked to prevent seepage of water, cleaned, and filled with concrete after the reinforcing steel had been set in them, together with grout pipes through which to inject cement binder down into the surrounding rock. This was done to insure stability, and provided an effectual seal and lateral support for the completed job. The major part of this work was done with Ingersoll-Rand Type WS Calyx core drills mounted on skids and capable of drilling 36-inch holes. An I-R Model SC Calyx drill, capable of putting down holes up to 72 inches in diameter, also was used. All these units were electrically driven. Accompanying pictures show the mounting of the drill rigs and the difficult field conditions that existed.

The 36-inch drills were not new to the Authority, and have been described in the previous articles. The 72-inch drill was track mounted, having a separate "A" frame for pulling the tools and cores. A 15-hp. electric main hoist and two 10-hp. independent electric hoists were furnished with the machine for pulling the tools, for tool control, and to handle the rock, core, or muck bucket. The 9-foot rotating spindle was driven by a 50-hp. motor, the load of the tools being carried on a heavy-duty, roller-bearing, 2-way water swivel. The weight of the entire outfit was approximately 8 tons. While this drill was used to put down only 36-inch holes on this particular job, it has a rated capacity of 72-inch holes up to 100 feet deep and 48-inch holes up to 200 feet deep.

Prior to the drilling of the 36-inch holes, a 6-inch pilot hole was put down at the center of each proposed concrete column. These small-diameter holes were carried down far enough to indicate the bottom of the larger holes and permitted grouting the working area to reduce water seepage and to stabilize the surrounding overburden. At first the pilot holes were drilled to the full desired depth before undertaking grouting; but it was found that under this procedure the upper part of most of the holes necessitated the use of casing. The method subsequently adopted consisted of drilling each 6-inch hole until a cavity in the rock was encountered or until water entered profusely. Then the drilled section was completely filled with grout under pressure; the pilot hole was redrilled through the grout; and operations continued in similar "stages" until the proper depth was reached. No casing was necessary with this method.

The upper portion of each 36-inch hole required casing, and for that reason the holes were started with a 49-inch bit. This diameter was carried down approximately 10 feet, and then 48-inch casing was put in place. A 47-inch bit was next used until the hole appeared unsafe, when that section was lined with 46-inch casing. This sequence of reduced-diameter bits and steel lining was continued until satisfactory rock was reached at depths varying from 35 to 85 feet. Most of the excavated material was removed from the holes by hand-loading it into muck buckets because it would not core sufficiently to be lifted out in one piece. In this formation, it was considered fair progress if a 3-foot cut was made with-

out changing the bit, and anything in excess of 4 feet was considered good.

At times, a 36-inch hole needed additional grouting to stop seepage. Under those conditions a tapered plug, 12 inches thick, was placed in the hole at the lowest possible elevation. It was made of 3-inch planking, with tar paper and oakum, and varied in diameter with the size of the casing. It was sealed to the latter by plugging and calking, and was braced for an upward pressure of approximately 15 to 20 tons. Grout was pumped through openings in this plug at a pressure of approximately 20 pounds per square inch. The mixture used had a water-cement ratio varying from 0.40 to 0.33 by weight, and contained calcium chloride equal to 3 per cent of the weight of the cement. This secondary grouting was not allowed to harden completely within the circumference of the casing so as to facilitate its removal by hand and Jackhamer operations.

Over a 6-month period, 2,241 feet of 36-inch hole was drilled, representing the 39 borings for the reinforced-concrete columns. The drilling rate averaged around 0.4 foot per gross hour, including all job delays. On holes of similar size outside the pier area the drilling rate averaged about 0.6 foot per gross hour, indicating that satisfactory progress was obtained by the method even under the severe conditions encountered. The 72-inch drill, which interchanged bits with the 36-inch machines, actually showed a net drilling rate greater than that of the 36-inch unit; but pulling tools and moving took more time, bringing the over-all production close to that of the 36-inch rigs. Approximately 10 pounds of shot was required per foot of hole. The bits were job made, being about 5 feet long initially and usually worn down to a length of 3 feet before being discarded. An accompanying sketch shows the action of the core-drill bits. The casing used was ¼-inch sheet steel rolled and welded to the proper diameter in approximately 10-foot lengths, a total of 1,750 lineal feet having been placed.

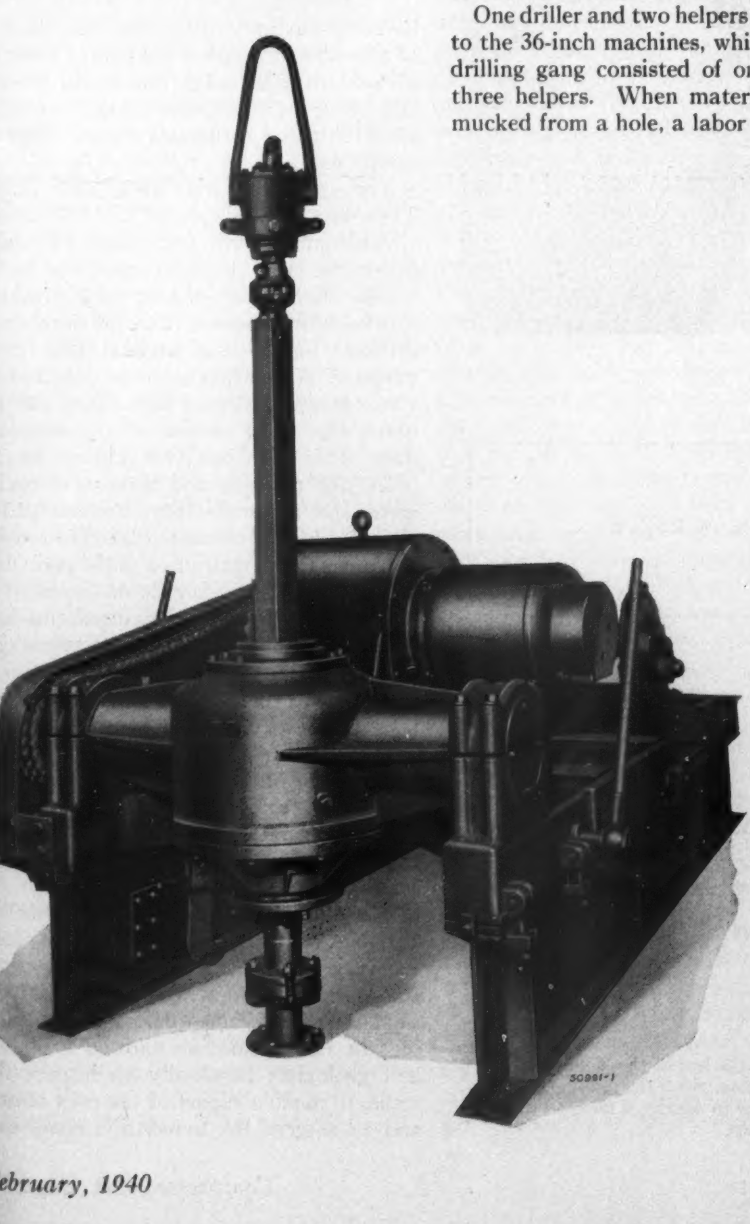
One driller and two helpers were assigned to the 36-inch machines, while the 72-inch drilling gang consisted of one driller and three helpers. When material had to be mucked from a hole, a labor crew was employed for that work, and the rig was skidded to another location to keep it in continual service. The electric motors on the 36-inch drills were stepped up from 15 hp. to 25-40 hp. in order to use 49-inch bits. The greater driving power did not result in an increase in repairs, indicating that each machine, as a whole, was structurally strong enough to take the added strain. The 72-inch drill was reinforced to take up excess vibration and to strengthen the main members when under severe loads. Upon completion of this job, the drills were removed from the area, cleaned, and serviced for future operations.

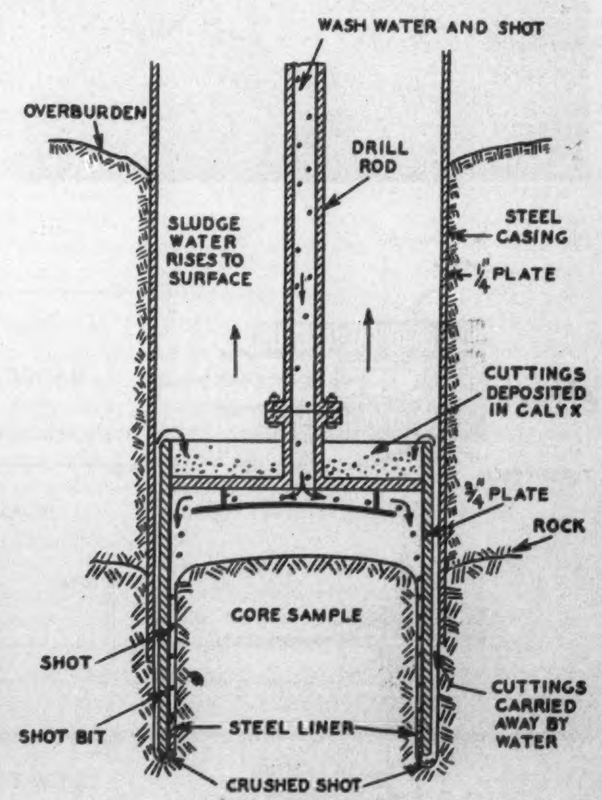
At Chickamauga Dam, Lee G. Warren is project manager; and the foundation work described was done under the direction of J. B. Hays, construction engineer, and F. C. Schlemmer, construction superintendent.

While the use of Calyx core drills for boring exploratory and other shafts up to 36 inches in diameter and more has come to be the accepted practice in the case of ordinary land operations, their application in connection with marine operations have differed with local conditions. Mountings have been devised ranging from crude wooden platforms to more elaborate rock-filled cribs or demountable steel structures, and these have made it possible to spot the drill at varying water levels. At the Watts Bar Dam site, the engineering and construction forces considered these methods; and, realizing the necessity of a standby

MODERN CALYX DRILL

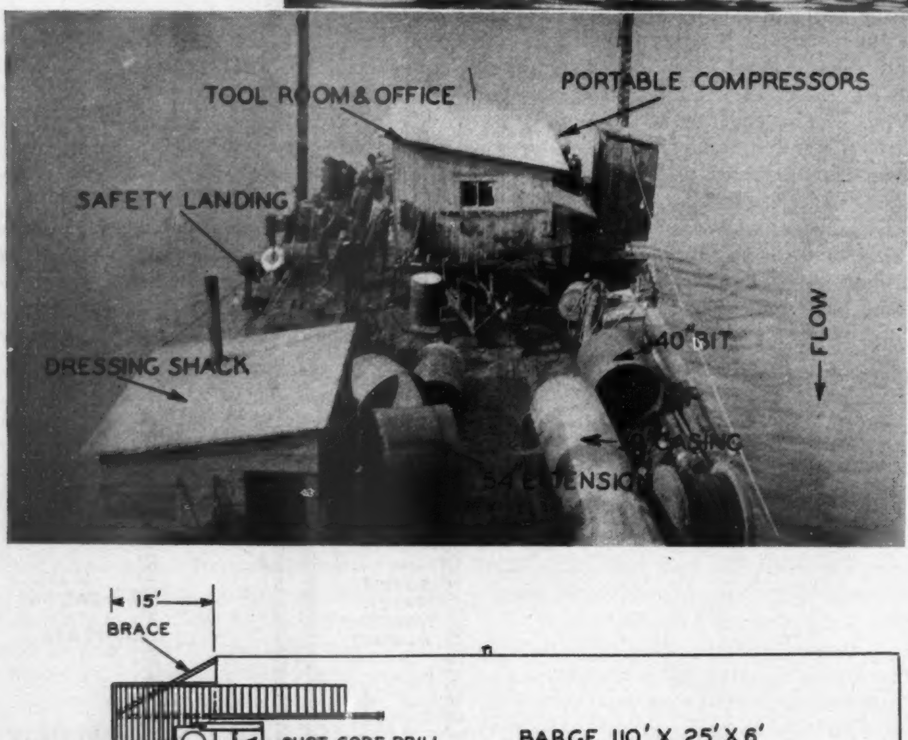
This Class TU-48 drill is the latest model in the line of Ingersoll-Rand Calyx core drills such as were used for the operations described in this article. This machine will take a 48-inch core, and was developed primarily for the sinking of mine ventilating shafts. Cutting speeds range from 6 to 18 inches per hour, depending upon the nature of the rock formation.

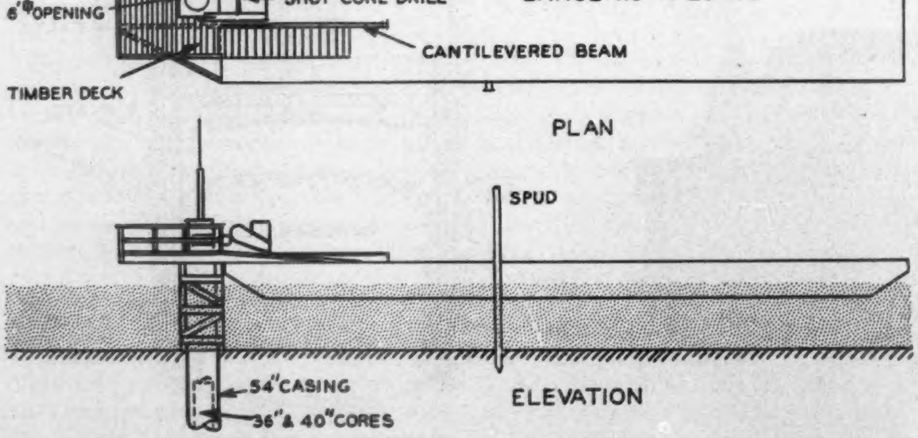




CALYX DRILL ACTION

The Calyx-core-drill bit is a cylindrical barrel, open at the bottom, and is revolved by a drill rod. Calyxite, or steel shot, is fed from above and gets beneath the bottom edge of the revolving bit through slots cut in it at intervals. The shot is crushed by the action of the bit and forms an abrasive that does the cutting.





FLOATING CORE DRILL

This craft enabled TVA engineers to drill holes in the dry in the bed of the Tennessee River, thereby permitting inspection in place of the materials on which the foundation of Watts Bar Dam is to rest. Three 36-inch holes were drilled to depths of from 50 to 70 feet. The drawings show details of the core-drill assembly.

barge for auxiliary equipment, they decided to assemble a complete temporary plant on a standard steel barge that could be centered over the hole location and from which all drilling and exploratory work could be conducted.

The operations were at a point in the Tennessee River about 60 miles above the Chickamauga Dam and about 100 miles below the large multipurpose reservoir at Norris Dam. The existing rock structure was fairly well known from previous shore drilling: but it was decided that more valuable information could be obtained by visual inspection of the formations directly under the main section of the proposed dam. This called for river drilling, for dry holes, and clean-up and removal of equipment and materials from the navigation channel. Steady currents were encountered by reason of the restriction of the main flow of the stream by rock wing dams placed so as to form a 7- to 9-foot river depth throughout a width of about 400 feet. Water stages at the site were affected by releases from the Norris Dam reservoir to meet downstream navigation and flood-control requirements. A forecaster in the Knoxville offices keeps all operations on the river advised of expected stream flows, a 30-hour period being allowed for the water to travel from the Norris Basin to the Watts Bar Dam job.

Three 36-inch-diameter holes were drilled to a depth of from 50 to 70 feet in rock having varied layers 3 to 24 inches thick and consisting of compacted shale and hard sandstone, with some quartz. These openings in the foundation allowed engineers and geologists personally to inspect the walls, to make a report of the rock strata, and to observe the foundation conditions

as indicated by the undisturbed formation. By use of the floating equipment each hole was excavated, unwatered, and recorded from the barge deck. Steel casing placed at the top of the first hole was removed for re-use on the succeeding borings, and the entire plant shifted to the next location.

For this work was purchased a new gasoline-driven, 36-inch core drill of the WS-3 type, while the auxiliary equipment was obtained from miscellaneous construction undertakings of the Authority. The layout of the barge and rigging for the various operations called for resourcefulness and adaptation of existing facilities. Steel spuds filled with concrete, each 30 feet long and weighing about 2 tons, were fastened to the barge. These were raised and lowered by a Clyde 54-hp., gasoline-driven, double-drum hoist that also served to propel and swing the barge by the aid of steel cable lines leading to shore anchors and to two 5-ton precast concrete anchor blocks that had been dropped in the river about 500 feet upstream.

The gasoline-driven hoist also was the "elephant" on the job during assembly and working periods. All heavy items were skidded from the railroad cars to trucks, to a ferry, and to the barge. An Ingersoll-Rand HU hoist, furnished later for mounting on the core drill and powered by a portable air compressor, came in for its share of auxiliary tugging with a varied assortment of anchors, such as trees, multiple part lines on all sizes of blocks, home-made rollers, skids, and ramps.

The steel barge was 110x25x6 feet, and was extended 15 feet at the downstream end by an improvised cantilever frame of two 12-inch I-beams bolted to the longitudinal deck channels. These beams were decked with planking, thus providing a working platform and a 6-foot-square opening from which drilling operations could be conducted. The sliding head of the core drill permitted retraction of the rod-turning mechanism. Sheave blocks, suspended from an A-frame, served to hoist and to give access to the platform or to the hole, and were connected to the side-mounted air hoist or to the chopping and hoisting winch on the drill countershaft.

Perhaps the most important arrangement conceived by the operating forces was the guide frame that was used to support the drilling tools and accessories when they were suspended in the water over the proposed hole. A timber cage was rigidly constructed to accommodate the 54-inch steel pipe which reached from above the water surface down into the river-bed muck and silt. The frame could be raised or lowered in between the extended I-beams; but when it was in working position it was bolted at the top to the beams. At the bottom, hemp guy ropes, leading to the corners of the barge, kept the frame vertical in the swift current.

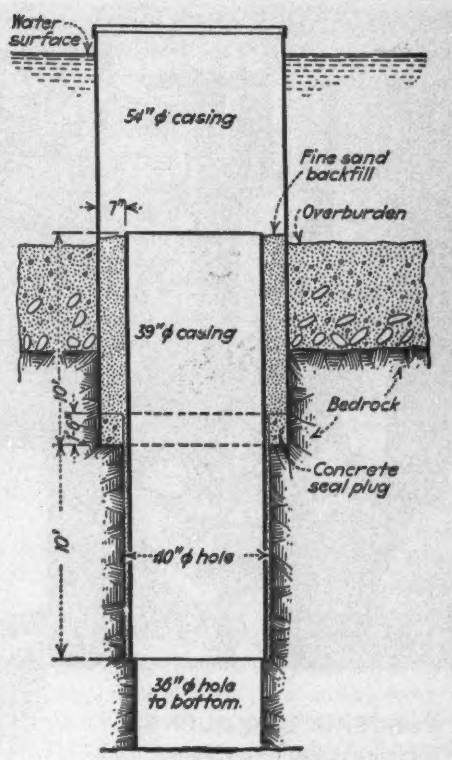
After spotting the rig, no time was lost in seating the first casing for the purpose of unwatering the hole. The welded 54-inch-diameter pipe was rotated through the overburden, being coupled to the drill by a specially made casing head and standard drill-rod connecting flanges. By chopping or driving, the cylinder was seated in the solid rock of the river bed, after which the loose material at the bottom was excavated with paving breakers and small orange-peel buckets. The casing was then sealed at the river bed by a sand-cement grout, which was allowed to set for about 48 hours. This work was generally done during the usual Friday p.m. to Monday a.m. shutdown, the hole being flooded to equalize the water pressure and thus to prevent percolation through the grout at the bottom of the hole.

A 40-inch standard bit was used for the first 10 feet in bed rock. After inspection of the formation for record purposes, 39-inch casing was set at that elevation and the space between the 54-inch and 39-inch pipes backfilled with sand. The regular 36-inch bit was carried down within the lower casing. Inspection, removal of the core, and handling of the drill rig then proceeded as in the case of land holes, the extended platform on the barge serving as the operating base.

Average progress of the 36-inch bit was about 5 inches per hour. Two-thirds of the time was required for mucking and one-third for drilling. The best hour of drilling reported was 3 feet; the best shift, 11 feet; and the best week, about 40 feet. Water pressure and shot feed were watched carefully because of the existing alternate layers of rock. The shale formation seemed to absorb the shot to some extent; and by reason of faster drilling and more cuttings, more wash-water pressure was exerted. In the sandstone strata, water pressure was cut down to avoid washing the shot away from under the bit. Shot consumption averaged 25 to 30 pounds per lineal foot of hole on account of losses in both classes of rock, and wear on the 36-inch bit was about 6 inches per 100 feet of drilling.

The complete plant operated two 8-hour shifts per day with a 5-man crew on each shift. Fuel consumed by the drill amounted to about 10 gallons of gasoline daily, and two air compressors averaged a total of 60 gallons a day operating sump pumps, Jackhamers, and the air hoist. A lighting plant and other gasoline-driven machines brought the fuel consumption up to about 75 gallons per day for the entire outfit.

A special device was installed to counteract the wall shock resulting from the suspended tools. This was termed a "wobble disk," and was attached to the drill rods just above the first joint from the bit end after the hole had reached a depth of 50 or 60 feet. It is claimed that it caused no noticeable interference with wash water or cuttings. A jib hoist on the left downstream spud was found to be indispensable in handling cores, tools, and supplies. It had a 10-ton Yale chain block; and was also used for incidental operations such as hoisting a launch, placed in a sling, out of the water for the making of major repairs.



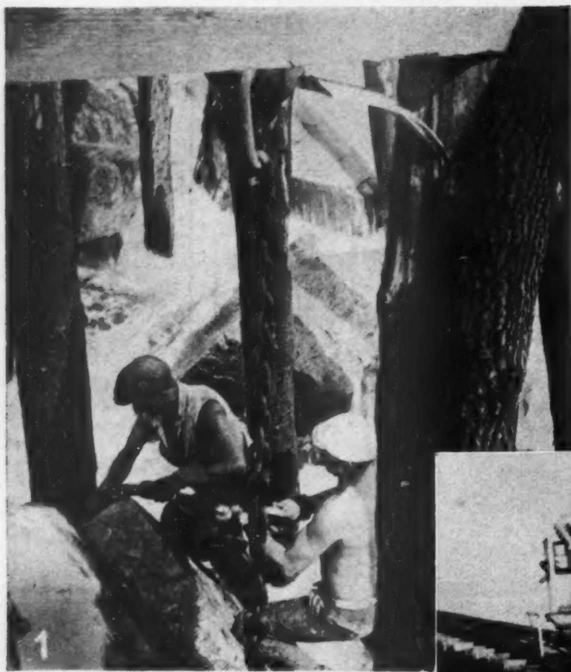
Engineering News-Record

RIVER HOLE SECTION

This sketch shows details of the telescoping casing by means of which it was possible to drill dry holes in the bed of the Tennessee River with a core drill mounted on a barge. The upper 54-inch casing served as a bit and was rotated through the overburden to bedrock. After it had been seated, it was mucked out and a bottom seal of grout placed.

The safety landing at the rear of the barge was typical of the thoroughness of the supervisory forces. It consisted of a wide platform at the water level with an easy ramp leading to the barge deck, and assured a sure footing for all landing and embarking activities. There was a clothes-change shack equipped with a hot-blast coal heater; and men were required to keep a complete change of work clothes on the job because of the wet hole conditions and the low seasonal temperatures. A tool house and office, and a toilet on the deck of the barge, completed the accessories of the plant.

The exploratory engineering on the Watts Bar dam site was in charge of J. S. Bowman, with Hendon R. Johnston as field engineer. Operations were directed by J. C. Blalock, under the supervision of Lee M. Ragsdale and T. D. Lebby. The board of directors of the Tennessee Valley Authority is composed of Dr. Harcourt A. Morgan, chairman, David E. Lilienthal, and James P. Pope. Gordon R. Clapp is general manager, and Theodore B. Parker is chief engineer. Sherman M. Woodward and A. L. Pauls are chief water control planning engineer and chief construction engineer, respectively. R. T. Colburn is construction plant engineer.



Barnegat Inlet Jetties

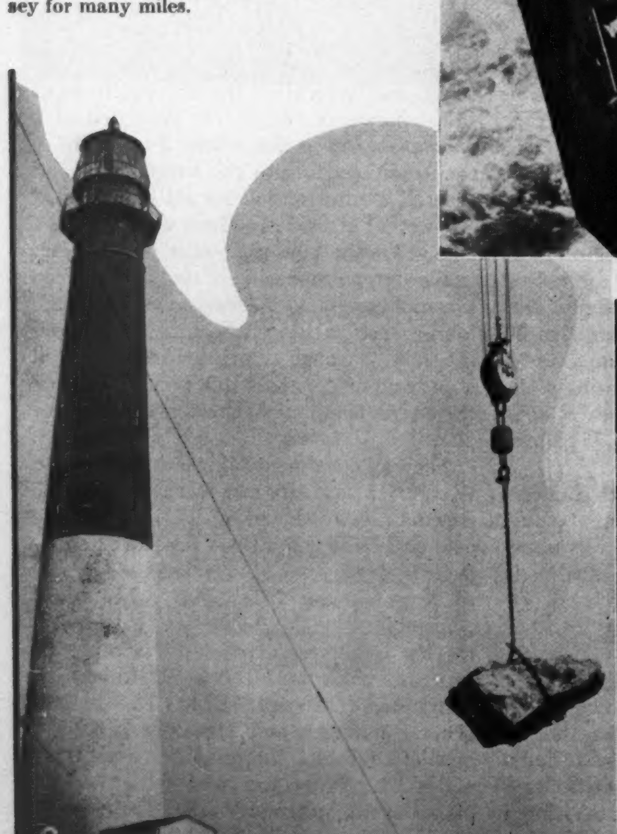
C. C. Harrington

CONSTRUCTION SCENES

1—Workmen adjusting a chain around a large rock that had to be reset. 2—Dumping a pan of small rock from the north trestle. 3—A 6-ton rock starts its journey across the inlet by cableway. 4—Compressed air for operating tools during the construction of the trestles was supplied by a 55-cfm. portable compressor mounted underneath the frame of a crawler crane. 5—Unloading a large rock from a trailer that hauled it many miles. 6—Map of the area of operations. Barnegat Inlet is a break in a long sand bar that parallels the main coast line of New Jersey for many miles.

FOR years the waters of Barnegat Inlet on the New Jersey Coast have been a source of danger and trouble to the hundreds of small boats that use this passage between the ocean and Barnegat Bay. Even in calm weather the currents surge through the inlet with such force as to continually change the course of the channel and to wear away the south shore. On that shore stands Barnegat Lighthouse, a historic monument that has guided navigation for years but has long since been replaced by a lightship. In rough weather the inlet becomes turbulent with giant waves and swiftly flowing currents that few boats are venturesome enough to tackle.

To tame these natural forces for the protection of the shore line and navigation, the U.S. Army Engineers are erecting two stone jetties on the ocean side of the inlet and creating a new and shorter boat channel. The latter was the first step in the program, and was excavated by pumping sand up from the bottom. It is 19 feet deep and 300 feet wide, and runs close to the north shore. As it is straight, it is less than half as long as the old, winding course. Some of the sand pumped from the bed of the new fairway was used to fill in spots in the old channel, thus putting an end to the swift currents that swept by and cut into the south shore.



The second phase of the job is the construction of two low-water, stone jetties on the ocean side of the inlet. The north jetty will project out into the sea for nearly a mile: the south structure will extend seaward about a quarter of a mile and will lie at an acute angle to the north jetty. When completed, the breakwaters will reduce the entrance to the inlet to a width of about 1,000 feet; and they are expected to have a quieting effect on the waters flowing through it. The jetties are being built entirely of rock and rise to an elevation of 2 feet above mean-low-water level at their outer ends. Their height is graduated, becoming less towards the offshore ends. In the case of the longer north jetty, the top is 10 feet above mean low water for the first 830 feet from the shore end. It then drops to an elevation of plus 8. This extends for 460 feet, after which there is another drop to elevation plus 5, which continues for 575 feet. A final transition reduces the elevation to plus 2 in the end section, which is 1,400 feet long. As high tide is 4 feet above mean low water, the structures will be submerged much of the time. A total of more than 78,000 tons of rock will be required for both breakwaters.

The first major problem was how to get the materials and equipment to the site of the north jetty. No road leads down the shore to this location, so the only method was to carry everything to the south shore and then across the inlet to the north shore. In order to accomplish this, the Eastern Engineering Company, which is doing the work under contract, erected two 165-foot steel towers, one on each side of the inlet. Between the towers was strung a cableway capable of sustaining a load of 20 tons. Over this cableway have been transported flat cars in sections, a dinky engine, piling and timber for the trestles, and all the rock for the north jetty. A railroad crane and the materials for the north cableway tower were taken across by barge.

The stone is being placed from trestles extending out along the line of each jetty and built of 35-foot piling and cross timbers. Compressed air supplied by Ingersoll-Rand machines was used for all the drilling work in the construction of the trestles, and pumps of the same make delivered water to the jets employed in sinking the piling. Each trestle carries a single railroad track on which operate a railroad crane and two flat cars drawn by a gasoline dinky engine. A spur under the cableway on the north shore permits switching the cars so that one can be left for loading while the other is being taken out on the trestle.

Each jetty is made up of stone of three general sizes. The foundation or mat consists of pieces weighing not less than 15 pounds and not more than 200 pounds. This mat is 2 feet thick where the total height of the jetty is less than 8 feet, and 3 feet thick where it is 8 feet or more high. On top of the mat is placed a core of quarry-run stone weighing from 15 pounds to 1 ton each. Overlying these two courses and extending down both side slopes to the sea floor is a retaining cover of large rocks weighing from 5 to 10 tons each.

Another problem was where to procure the necessary 78,000 tons of stone for the jetties. In this land of sand and sea, rocks are unknown. It was therefore necessary to send 80 miles to the quarries at Pennington, Kingston, and Lambertville in order to get the material for the work. The subcontractor, Pennington Trap Rock Company, spent nearly $100,000 for a new fleet of ten diesel-powered tractors and trailers to haul it. These vehicles are licensed to carry up to 20 tons per load, and are averaging better than 9 miles per gallon of fuel oil on the trips.

The small mat rock is transported in steel pans holding about 6 tons each. These are lifted bodily from the trailers by the cableway or by the crawler crane and swung across the inlet if intended for the north jetty, or they are loaded on to flat cars for the south jetty. The large pieces of stone are placed on the trailer individually, and there are generally three rocks to a load. They are removed by chain slings, care being taken so that they will not be broken.

On the long run through the flat country, the vehicles make excellent time. The drivers stop twice on each loaded trip to the shore to check their tires for air pressure. If a tire gets soft, it is immediately reinflated, or the driver waits for a returning truck to give him a tire without a leak, as no spares are carried. Bonuses are given to the men who keep their tires in good condition.

Small stone for the north jetty is transported by the cableway in 6-ton lots in the steel pans. Six of these can be put on a flat car and pulled out on the trestle to the point where the jetty is being built. The railroad crane dumps the pans, after which they are returned to the cableway. Meanwhile, another flat car under the cableway has been loaded. The large pieces of rock travel separately over the same route, chain slings being used instead of the pans. The placing of these cover stones, however, is a difficult and exacting operation. With 20-foot waves banging against the trestle, and with only a steam railroad crane to do the work, this rigging job calls for considerable skill and patience. When a rock is misplaced, a rigger has to go down into the water and reset the sling for another attempt.

The south jetty is being built in a similar way, except that a crawler crane can load rock directly from the trucks or a storage pile on to flat cars. When the breakwaters are completed, the piling of both trestles will be removed and two beacon lights will be placed at the far ends of the jetties. These are being erected on steel cylinders and will mark the 1,000-foot entrance to the inlet. The Government appropriation for the entire undertaking is $600,000. Bert Jaggard is construction superintendent on the job for the Eastern Engineering Company.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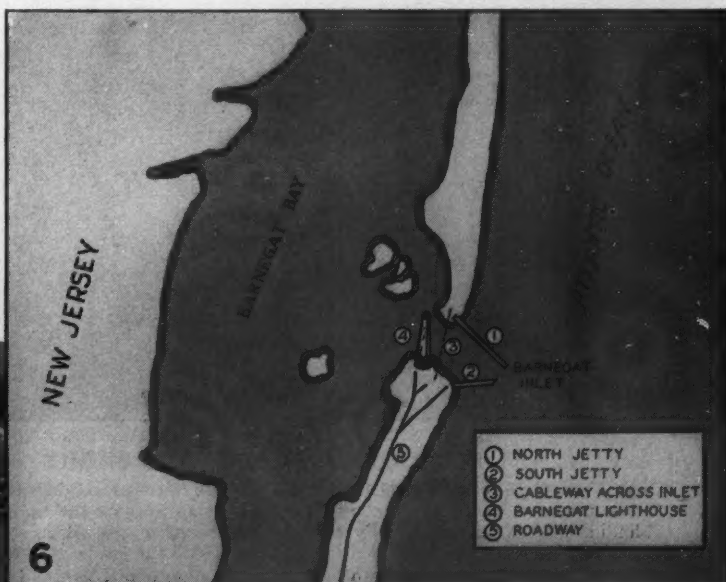

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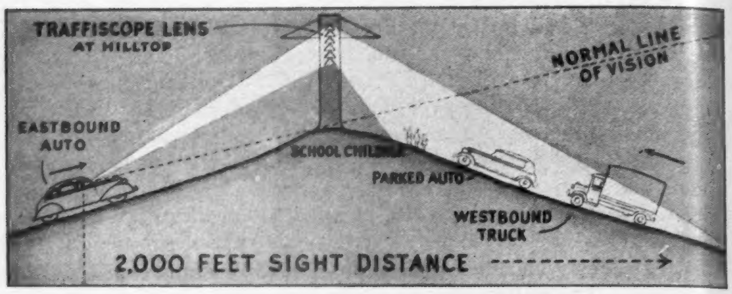
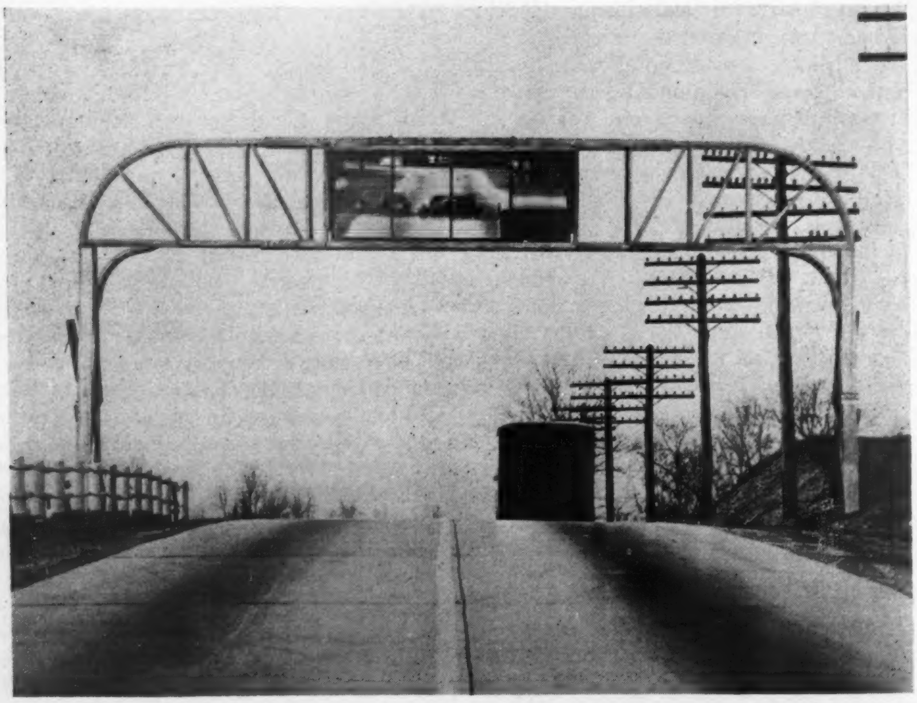
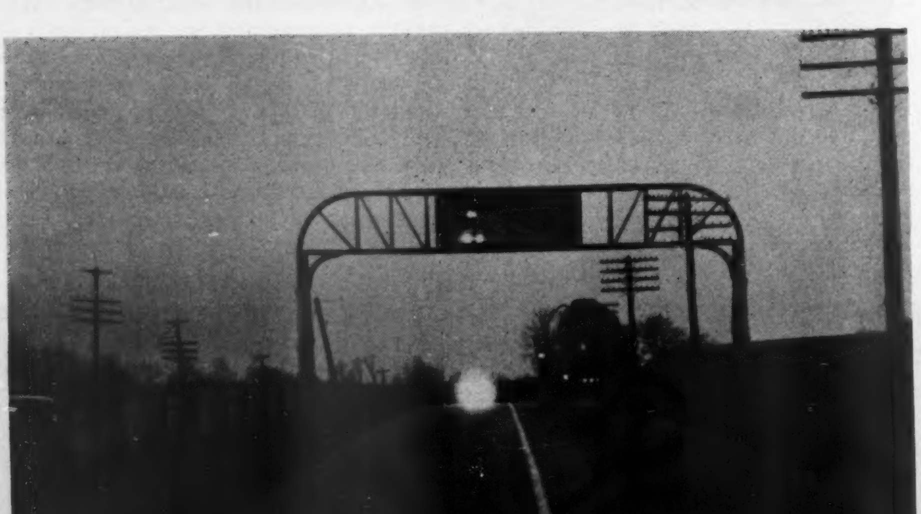
Over the Hilltop with Safety







STANDS GUARD DAY AND NIGHT

The Traffiscope is said to be effective under all weather conditions and at night, being mounted high enough above the roadway to prevent the transmission of the blinding rays of headlights. By changing the shape of the prisms, the angle of refraction of the lens can be varied in accordance with the grade so as to give a motorist approaching the crest of a hill from either direction a minimum sight distance of 2,000 feet, as indicated in the drawing at the top.

IF MOTORISTS who have the dangerous habit of passing cars on the upgrade could see what's ahead, there might be fewer hilltop accidents. As people who refuse to obey traffic rules will always be with us, two Minneapolis men, R. M. Cooley, a former highway engineer, and R. R. Rand, Jr., have invented a device to protect safe drivers from such accidents and also to prevent trucks and buses, climbing slowly upgrade, from holding up a long line of passenger cars when the way on the far side of the hill is clear. It's the Traffiscope, which is designed to straddle the road at the top of a rise and to give the man at the wheel a perfect view of what is beyond the crest long before he reaches it.

Set in the center of the steel framework of the structure is a composite lens which, for the regular 4-lane highway, is about 13 feet long and 5 feet high. This is made up of four banks of oblong glass prisms each 40 inches long, 4 inches high, and 1½ inches thick at the base. There are seventeen prisms in each bank, mounted one above the other, and they are so proportioned that the lens as a whole gives an unbroken picture of what lies ahead. The construction is flexible so that a lens of any desired width and height and with the necessary angle of refraction can be provided to meet local conditions.

As a motorist approaches the Traffiscope, he sees in the glass lens the stretch of road immediately beyond the summit. He receives a full but flattened view of it which does not interfere with normal judgment of distances: and the image of any object coming toward him moves from the top of the lens to the bottom, where it disappears a few seconds after the actual object reaches the hilltop and comes into sight. The safety tower is said to work equally well at night, as the glare from powerful headlights is not transmitted by the lens. To protect the latter from obscuring moisture it is provided with hoods that project out far enough to create pockets of dead air.

Several Traffiscopes have been set up in different parts of the country for test purposes. There is one on Route 5 eight miles south of Hartford, Conn., and another on Route 230 southeast of Harrisburg, Pa. These are of improved design. Still another stands guard a few miles south of Minneapolis, Minn., on Route 65. This is the initial installation. It has been in service since April, 1937, and in the meantime no accidents have occurred at what was previously a danger spot.

THE FATHER OF PRINTING

FEBRUARY marks the anniversary of the death of John Gutenberg, who is generally conceded to have originated the art of printing as we now know it. Gutenberg died on February 24, 1468. His contribution to typography was movable type made up in individual pieces so as to permit its re-use. The effect of this invention on the advancement of education has been incalculable, for the progress in civilization in the various parts of the earth has been more or less proportionate to the dissemination of the printed word.

Gutenberg suffered the fate of many notable inventors. Being poor, he had to place his trust in others who had money, and they took advantage of him. In 1435 he entered into partnership with Andrew Dritzehn, John Riff, and Andrew Heilmann, citizens of Strassburg, Germany, binding himself to disclose certain secrets connected with the art of printing that gave promise of making them all rich. Dritzehn died shortly after work had been started; and as the shop was in his house, Gutenberg sent word by his servant to Nicholas Dritzehn, brother of the deceased, to keep all persons out lest the secret be discovered and the printing forms stolen. However, the forms had already disappeared; and shortly afterward Nicholas claimed his brother's share in the undertaking. A lawsuit among the partners followed. This clearly established that Gutenberg was the first person to practice the art of printing with movable type. The partnership was dissolved, and Gutenberg, without funds, returned to his native city of Mainz to start anew.

Determined to capitalize on his invention, he persuaded a wealthy goldsmith, John Fust, to advance the necessary money, and they set up a shop. Between 1450 and 1455 they printed in Latin a complete edition of the Bible. It covered 637 leaves, and a copy of it is preserved in a Berlin library. It is believed that each piece of metal type was cut by hand, the process of casting being generally ascribed to Gutenberg's successor, Peter Schoeffer. The latter started as an apprentice with Fust. The expense of preparing the Bible was greater than Fust had expected, and he brought suit against Gutenberg, claiming he had misrepresented the cost. The finding was against Gutenberg, who was commanded to repay some of the money advanced, with interest. He was unable to do this, and the partnership was severed. All the apparatus remained in Fust's possession, and he carried on the work with Schoeffer's help. Little is known of Gutenberg's endeavors after that time, except that for three years he received a pension from Archbishop Adolphus.

The art of printing spread rapidly, and many towns had printing plants by 1475. Since religious works predominated, much of the early printing was in the hands of the Catholic Church. Nuns had served for many years as copyists of manuscripts, and it was only natural that they should take up printing. One of the first establishments operated by them was in the convent of St. James at Mt. Ripoli, Italy. During the period 1476 to 1484, they turned out more than 100 works.

OIL AND THE WAR

MANY observers are of the opinion that the outcome of the current European war hinges upon the question whether or not Germany is to continue to obtain an adequate supply of petroleum to keep her military machine running in high gear. Right now, Rumania seems to be the only country that Germany can look to for a sustained supply. Consequently, the policy of distribution of Rumanian oil that is to be worked out by her eventually, or that is to be imposed upon her by the belligerents, will become war news of the first order.

Rumania produces around 50,000,000 barrels of petroleum annually, and has a surplus of 35,000,000 barrels for export. This approximates 100,000 barrels a day. Germany has contracts covering 45,000 barrels a day, but with the Danube River frozen it is impossible to ship that amount. This is so because Germany has, surprisingly, neglected to maintain her railroad rolling stock. Tank cars are needed to transport crude or refined oil, and their number is deficient.

Meanwhile, the question arises as to the continuance of the agreement to provide the Reich with petroleum. The situation is peculiar because three-fourths of the oil industry in Rumania is controlled by outside nations, among which Great Britain and France are the strongest. However, the disposition of the oil rests with the Rumanian Government, which has placed the matter in the hands of a dictator.

During the current interim in which the ultimate course of Rumanian oil is being determined, drastic rationing of gasoline is being enforced by all the nations that are parties to the war and even by several neutral countries that fear they may be drawn into the conflict. The regulations are most stringent in Germany.

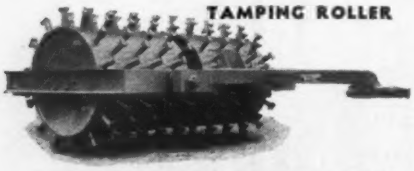
Substitutes for gasoline are being extensively used. These range from sewer gas to synthetic motor fuel. In England, gas bags atop automobiles are common. They hold coal gas, the amount being equivalent to half a gallon of gasoline. Obviously, the supply must be frequently replenished. Gas generators that can be attached to cars or towed behind them on trailers are appearing in larger numbers. In Germany there is more of a trend towards compression of the substitute gases so that comparatively large quantities of them can be carried in small containers.

These substitute fuels are passably satisfactory for driving automobiles and other land vehicles, but they are useless, of course, for airplanes. Since modern warfare depends so much on aerial activity, the question of whether both sides are to continue to receive ample supplies of petroleum looms increasingly important.

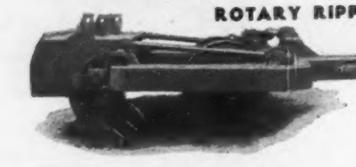
New Tractor Equipment for Constructors

BUCYRUS-ERIE Company has added two lines to its tractor equipment, according to a recent announcement, and is now prepared to deliver rippers and tamping rollers. The latter are available in single-, double-, or triple-drum models with 72, 96, or 112 easily renewable feet on each drum and with rear-pull connections for working in trains. The double- and triple-drum rollers have oscillating drums so they can adapt themselves to uneven ground surfaces; and all drums have openings for ballast. The rippers are of the rotary and the heavy-duty, cable-operated type. A feature of the former, says the builder, is the rotating head which quickly swings the standards up and back and around again to ripping position, making it especially suitable for work in material containing bowlders and heavy roots. Complete rotation of the head also dislodges rocks and debris caught between the standards and prevents the ripper from picking up the same material twice. The heavy-duty ripper is designed for breaking up shale, hardpan, decomposed granite, sandstone, old macadam, etc., that is exceptionally hard to dig and load. Its standards can penetrate full length below ground level—that is, 17 and 24 inches for Models CR-1 and CR-2, respectively—and can be set at any intermediate point or raised for traveling. Further information about these new products are contained in a bulletin which can be obtained from the Bucyrus-Erie Company, South Milwaukee, Wis.

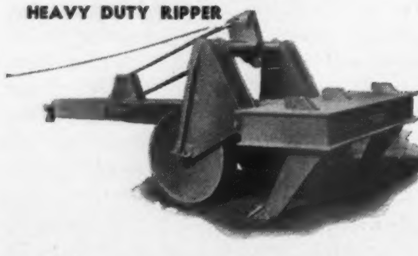
TAMPING ROLLER



ROTARY RIPPER



HEAVY DUTY RIPPER



Aluminum from Phonolite

SCARCITY of bauxite in certain regions is causing some producers of aluminum to turn to phonolite as a source of raw material. According to *Mineral Trade Notes*, the three principal components of the mineral—alumina, alkali, and calcium silicate—can be utilized economically, the first in the manufacture of aluminum, the second for processing into potassium and sodium carbonate, and the third in the making of cement.

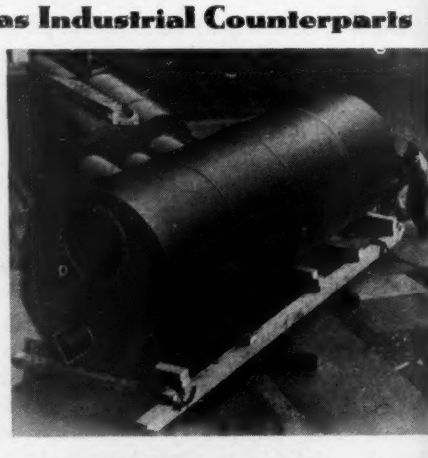
In the production of alumina, alkali is added to the finely ground phonolite, which is then mixed with sufficient powdered limestone to form silicic-acid calcium-orthosilicate. Sintering at around 2,192°F. splits the phonolite-silicate complex so that the alkali in the mineral (together with that added to it) and the alumina form alkali-aluminate, while the silicic acid is united with the lime. Sintering is done in rotary furnaces in such a manner that the mass remains porous—does not become fused. The product is processed by means of soda, the same as in the case of pyrogenic decomposition of bauxite. Leaching yields a potassium-sodium aluminate liquor from which pure alumina is obtained in the customary way. The well-washed-out residue, incorporating chiefly calcium silicate, is especially suitable for the manufacture of cement because it is silt-like in character and ready for use.

Suppressed Gun Silencer Has Industrial Counterparts

IT SOUNDS paradoxical to speak of a scientific development that is so efficient as to cause its own downfall, yet the statement is true when applied to the Maxim gun silencer and the Maxim gun itself. Nearly 40 years ago, Hiram Percy Maxim invented a revolutionary device that rendered the explosion of firearms practically noiseless. Its potentialities were immediately recognized, and in 1909 The Maxim Silent Firearms Company was organized to manufacture it. The silencer became popular and was used on sporting rifles and also to a considerable extent on high-powered military rifles, having been adopted at one time by the United States Army as standard equipment. However, its very efficiency made it a social menace in the hands of members of the underworld; and the authorities eventually felt compelled to discourage its production.

In the meantime its manufacturers had realized that the silencer could be adapted for use with other than firearms. They dissolved The Maxim Silent Firearms Company and organized The Maxim Silencer Company. The first product was a silencer for motorboat engines; next, the development of diesel engines created a demand for exhaust and intake silencers, and the business expanded greatly. This trend has continued until the concern now offers 26 models, each built in 22 sizes, as standard items. Among them are silencers to eliminate the noises made by internal-combustion engines, compressors, blowers, vacuum pumps, high-velocity steam and air discharges, etc.

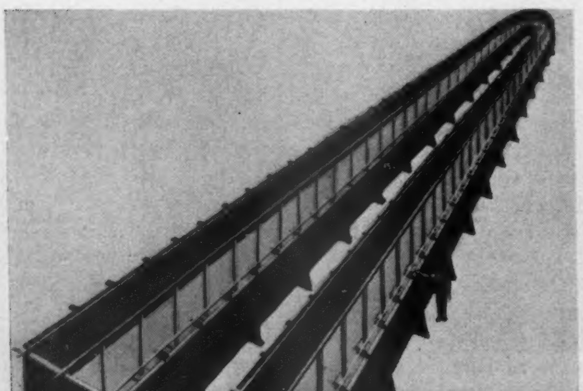
As the number of silencers in use multiplied, so has there been a notable increase in the dimensions of the units produced, as shown by the accompanying illustration of a 30-inch-pipe-size combination silencer and spark catcher for the exhaust of a 3,800-hp. marine diesel engine.



LARGE SILENCER

This apparatus, weighing 8,000 pounds, is one of the modern industrial evolutions of the former Maxim gun silencer that weighed 8 ounces.

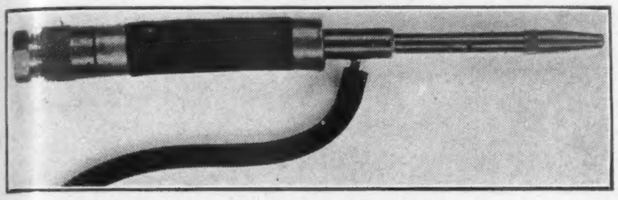
SPEEDS UP WORK OF NICKEL-PLATING



This nickel-plating tank with its hairpin bend has a number of features that probably distinguish it from others in that service. The workman standing alongside gives a good idea of its length, which is 162 feet. It was designed and built in seven sections in the plant of the Paramount Rubber Service, Inc., and has a seamless rubber or Impervium lining, a substance produced through the joint efforts of Paramount and the Dow Chemical Company. This material is said to be proof against oils, acids, alkalies, and other reagents, and to have high dielectric properties. As a further protection, the outer surfaces of the tank have been coated with Surfaseal, a rubber paint.

Industrial Notes

A spray gun of a new type has been developed by the Lonn Manufacturing Company for removing grease, oil, and dirt from motors, engines, and inaccessible parts



of machinery generally by the application of kerosene or other cleaning fluids. It is 10½ inches long and looks much like a screwdriver, as the accompanying illustration shows. The air line is secured directly to the end of the handle, which is flexible and contains a shut-off valve to the head of which is attached a long stem. This valve is interposed between the air and the fluid connections and is unseated simply by bending the handle out of line. As the air thus admitted flows through the gun, the suction created draws the cleaning fluid from its container up through the 5-foot hose connection and discharges it from the nozzle in the form of a fine spray. The fluid hose is made of oil-resisting Neoprene; and compressed air at from 100 to 150 pounds pressure per square inch is recommended, although lower-pressure air can be used. The Model GW engine and parts cleaner, with the fluid line disconnected, will do duty as a blow gun. The price of the cleaner is $6, including 5 feet of hose.

Under the trade name of Colorfloor, Flexrock is offering a new paint for finishing and sealing the surfaces of wood and concrete floors. It comes in four colors—tile red, linoleum brown, battleship gray, and emerald green—and is said to give a glossy, wear-resisting coat.

The principal feature of a new type of flashlight is that it is self-contained—generates its own "juice." Instead of a battery it is provided with a small generator that is operated by the pressure of the hand. It is sold under the name of Viz-Lite.

Imperial Chemical Industries, Ltd., has developed a fireproof finish as a protection against small incendiary bombs that may penetrate roofs and lodge in the upper floors of buildings. The product is a mineral plastic in powder form and is mixed with water in the proportion of 3 to 1, respectively.

For first aid in case of burns, Davis Emergency Equipment Corporation is offering a jelly which has been named Tannoid because it contains some tannic acid. The preparation is put up in a collapsible tube to facilitate spreading, and is readily soluble in water. It is said to relieve pain, to lessen toxic effect, and to minimize formation of scar tissue.

Extensive use is being made in Japan of a new interior and exterior building material called Platon Board, according to the U. S. Commercial Attache in Tokyo. It is

AUSTIN DAM TAKES FORM

In our June, 1939, issue we described the reconstruction of Austin Dam at Austin, Tex. This picture, which was taken on December 30, 1939, indicates that the work is well on its way to completion. It is a view from downstream, showing a part of the rebuilt hollow, reinforced-concrete section with surmounting Taintor gates. In the foreground various types of equipment are being used to drill drainage holes in the apron. Included are seven Ingersoll-Rand Calyx core drills and five Ingersoll-Rand wagon drills. Austin Dam is on the Colorado River, and its reconstruction is in charge of the Lower Colorado River Authority, of which Robert B. Alsop is superintendent of construction.

made under a patented process from pine wood and cement, and is said to deaden sound and to be moisture- and insectproof.

With the ever-present menace of complete blackouts in the warring countries by failure of the main supply of electricity, there has been developed a self-contained battery set for emergency use that will give light continuously for from 20 to 30 hours. It includes a 12-volt battery, a charging unit, and two 9-foot cords each fitted with a lamp and shield ready to be plugged into sockets on the front panel of the cabinet, which measures 24x12x8 inches and weighs around 35 pounds. Where more light is required, as in the case of a hospital, for example, sockets for four extra lamps are provided. The charger, together with the bulbs and accessories, is housed in the top half of the cabinet and will operate on any standard alternating-current circuit of 200-250 volts.

At the Seventh World's Poultry Congress held not long ago in Cleveland, Ohio, the U.S. Government demonstrated a new treatment for eggs that are to be placed in cold storage. It is known as the vacuum carbon dioxide-oil treatment, and was developed by the Bureau of Chemistry and Engineering of the Department of Agriculture to maintain the quality of that food. By means of it, the eggs are first subjected to a vacuum to exhaust the contained air. While in that state they are dipped in mineral oil, after which suction is discontinued and the pressure thus induced forces the oil, together with carbon dioxide, into the open pores of the shells. The effect of the treatment is to prevent the loss of moisture and the chemical change that normally cause eggs to deteriorate. The process is being used commercially; and it is said that eggs so sealed and kept in cold storage for six months are as good as fresh ones.

What is known as a surface indicator has been produced by the General Electric Company. The instrument is used to determine the smoothness of metal or painted surfaces, and is so sensitive that it will register variations, or differences in thickness, of as little as 1/1,000,000 inch. The apparatus has the appearance of a phonograph, complete with a sapphire-pointed needle. The object to be tested is placed on the turntable, and, as the hard stylus passes over it in revolving, there are created weak mechanical impulses which are converted by an electromagnetic pickup into electrical impulses. These are amplified and transmitted to a recording meter on which the surface irregularities or characteristics of the test piece are graphically indicated. The instrument is the work of J. A. Sams of the General Electric Company and is being used to advantage in determining the smoothness of bearings or other moving parts of motors, etc., that are subjected to wear.